FIG. 1A

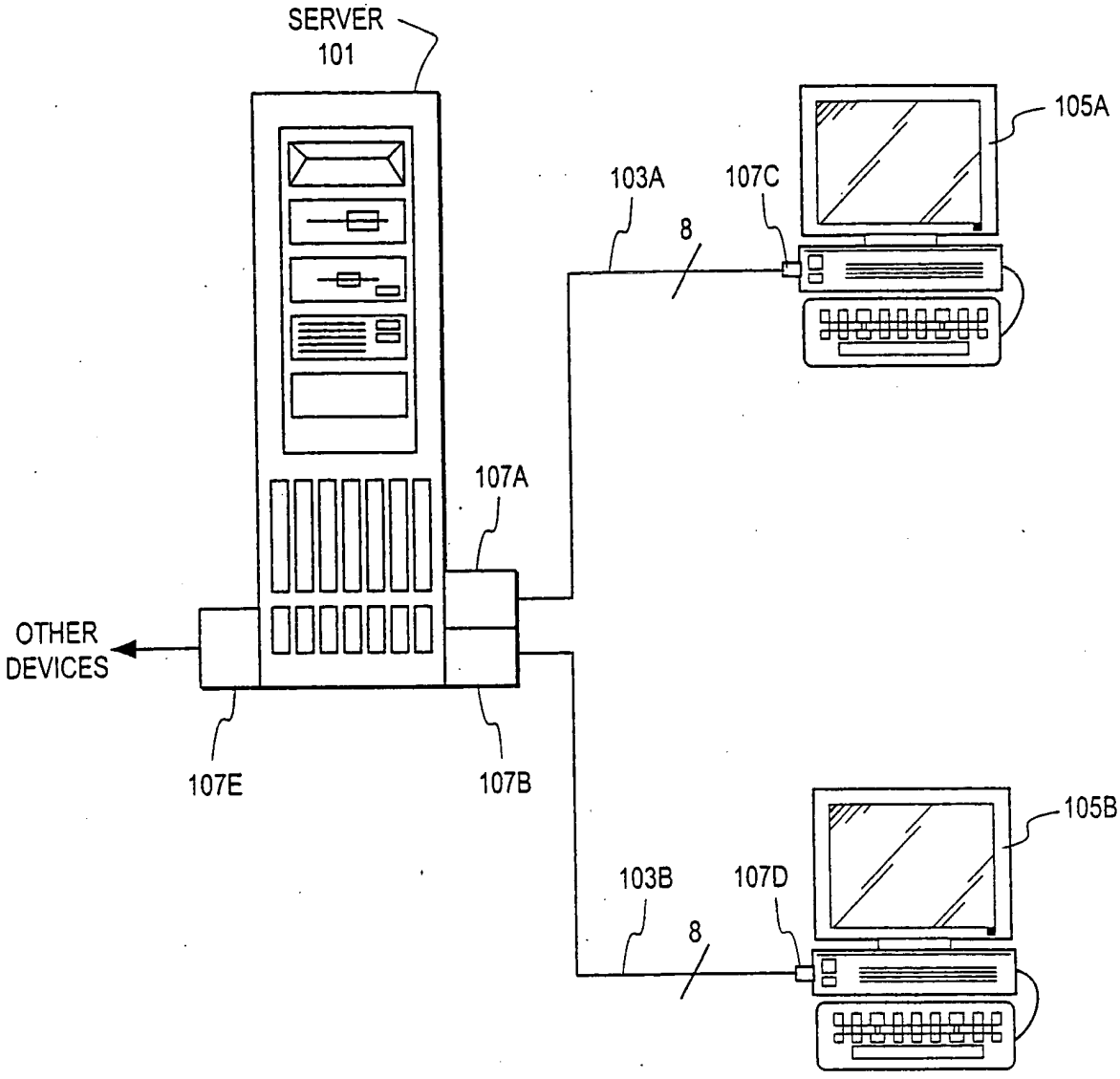
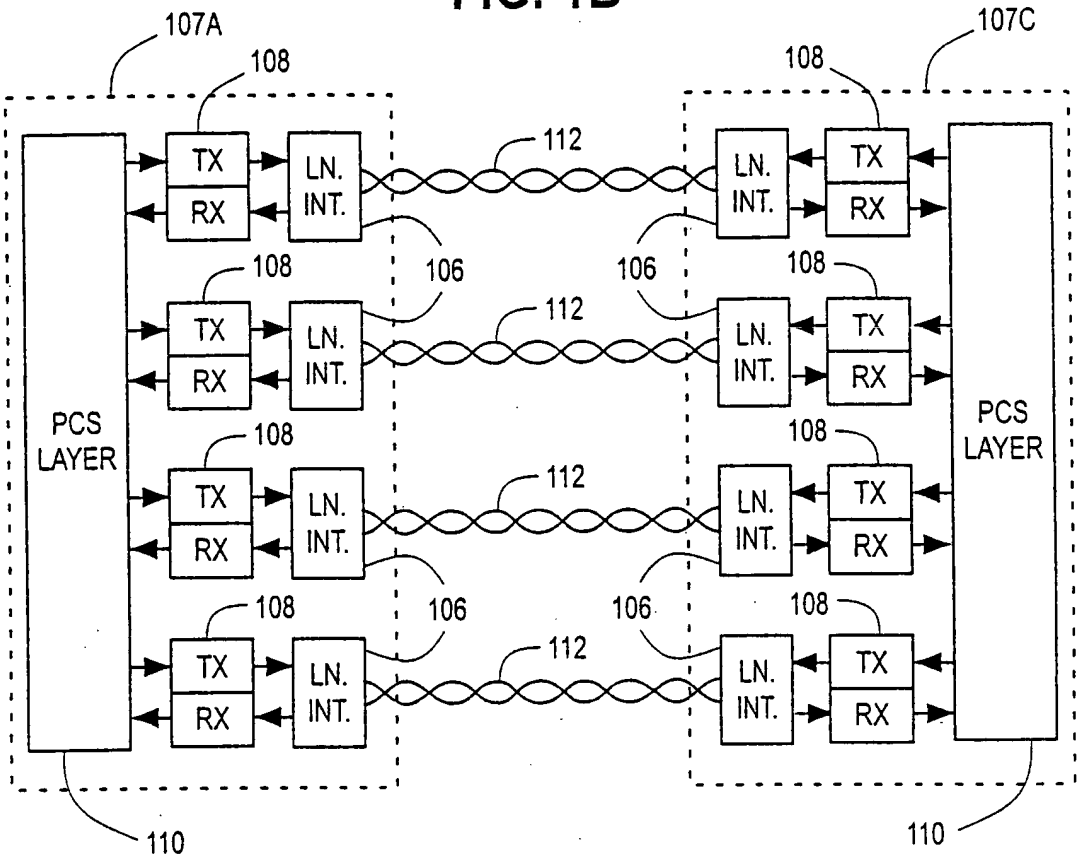

SERVER
101
105A
103A
107C
8
107A
OTHER
DEVICES
107E
107B
105B
103B
107D
8

FIG. 1B



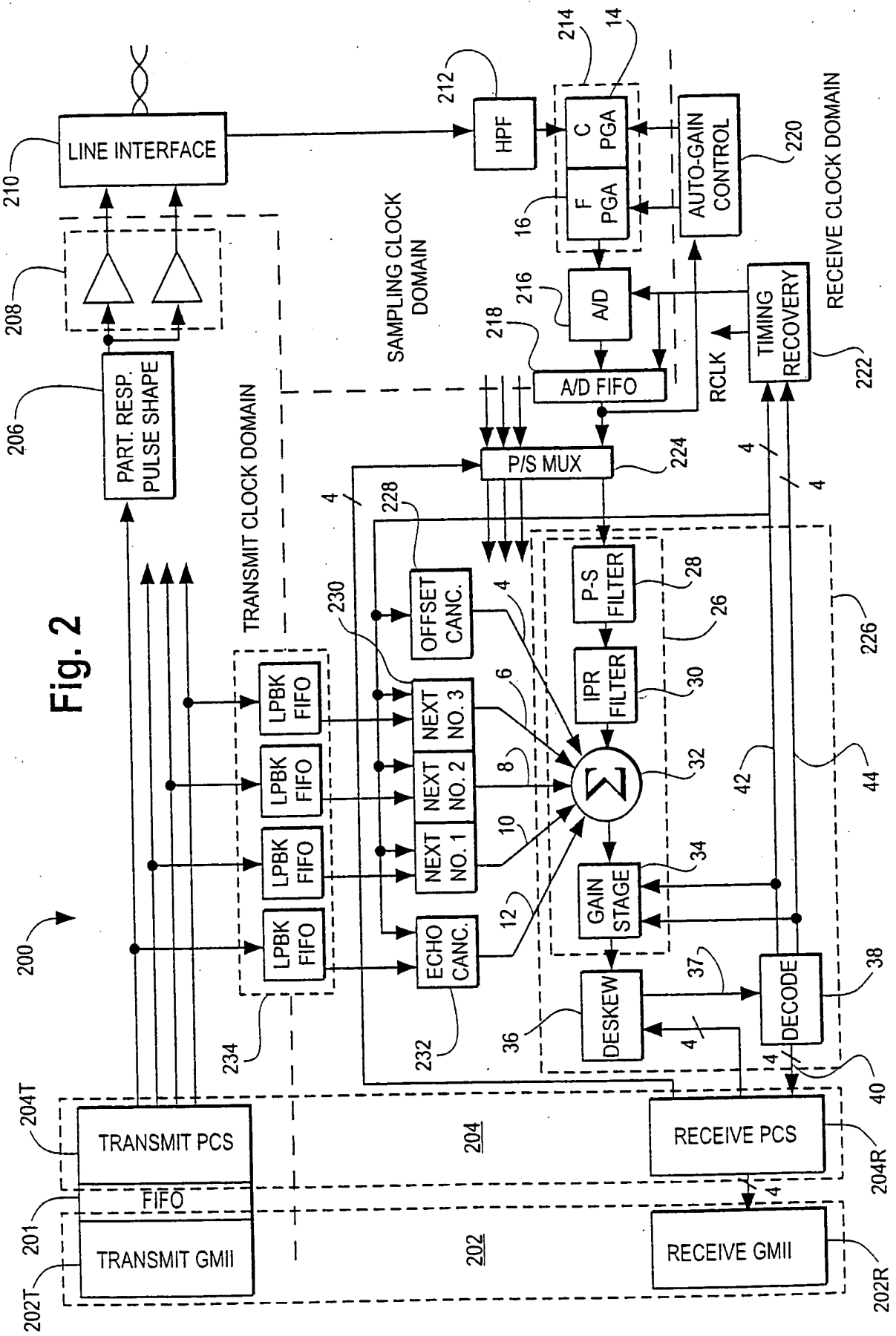

LINE INTERFACE
210
208
206
PART. RESP. PULSE SHAPE
HPF
212
214
14
C PGA
F PGA
16
AUTO-GAIN CONTROL
220
A/D
216
218
A/D FIFO
TIMING RECOVERY
222
RCLK
RECEIVE CLOCK DOMAIN
SAMPLING CLOCK DOMAIN
TRANSMIT CLOCK DOMAIN
P/S MUX
224
4
228
OFFSET CANC.
230
LPBK FIFO
LPBK FIFO
LPBK FIFO
LPBK FIFO
NEXT NO. 3
NEXT NO. 2
NEXT NO. 1
ECHO CANC.
6
8
10
12
Σ
32
P-S FILTER
28
IPR FILTER
30
26
GAIN STAGE
34
DESKEW
36
37
DECODE
38
42
44
226
40
200
234
232
204T
TRANSMIT PCS
204
RECEIVE PCS
204R
FIFO
201
TRANSMIT GMII
202
RECEIVE GMII
202T
202R

Fig. 2

FIG. 3

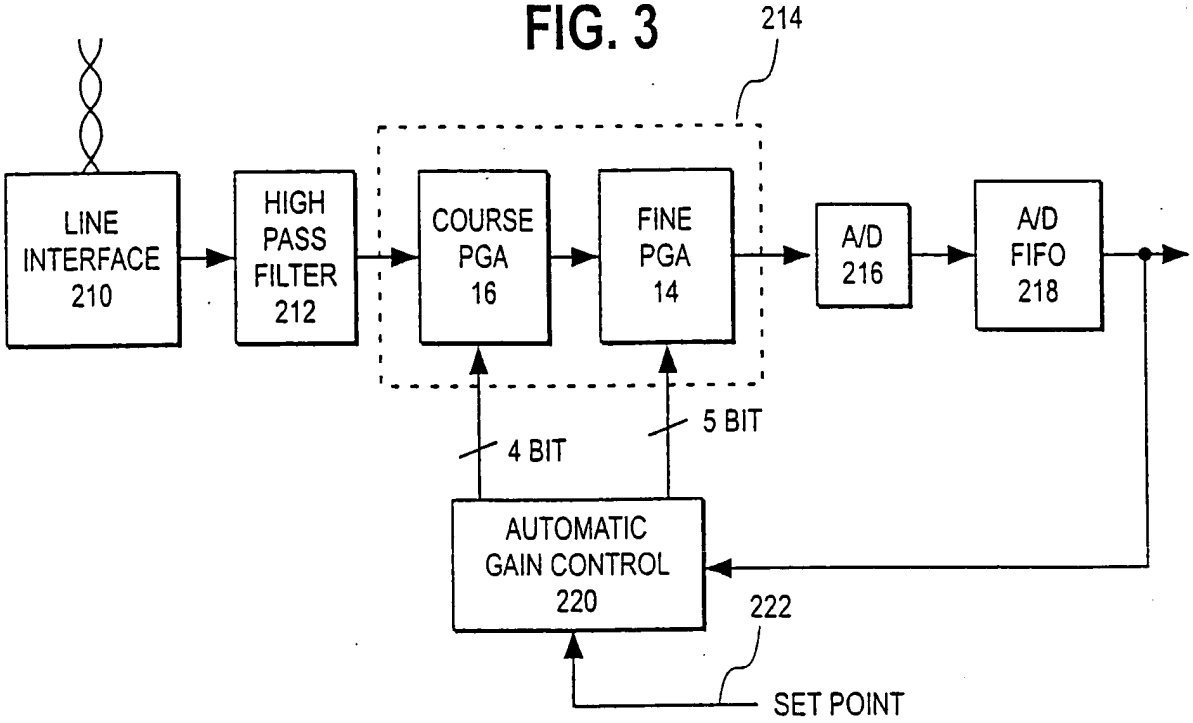

214
LINE INTERFACE 210
HIGH PASS FILTER 212
COURSE PGA 16
FINE PGA 14
A/D 216
A/D FIFO 218
4 BIT
5 BIT
AUTOMATIC GAIN CONTROL 220
222
SET POINT

FIG. 4

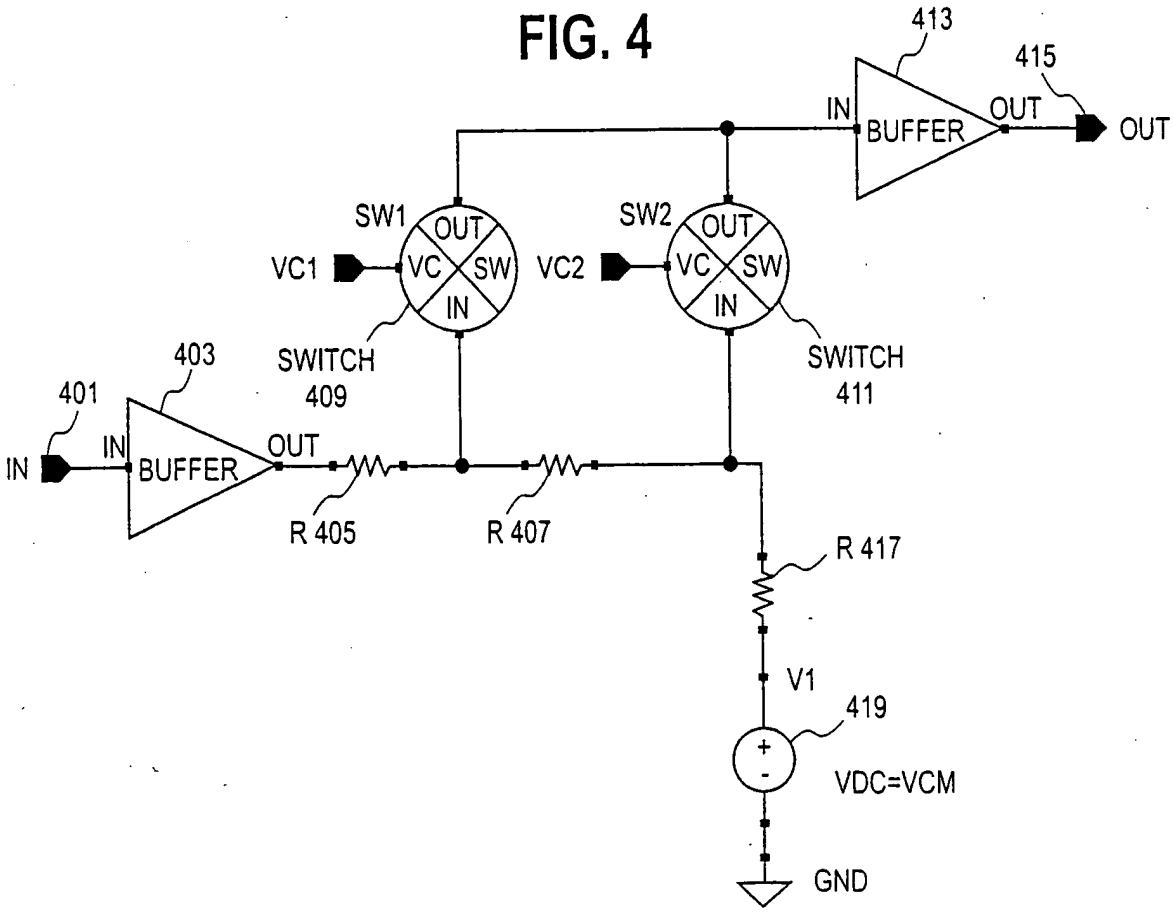

413
415
IN
BUFFER
OUT
OUT
SW1
SW2
OUT
VC1
VC
SW
IN
VC2
SWITCH 409
SWITCH 411
403
401
IN
BUFFER
OUT
R 405
R 407
R 417
V1
419
VDC=VCM
GND

FIG. 5

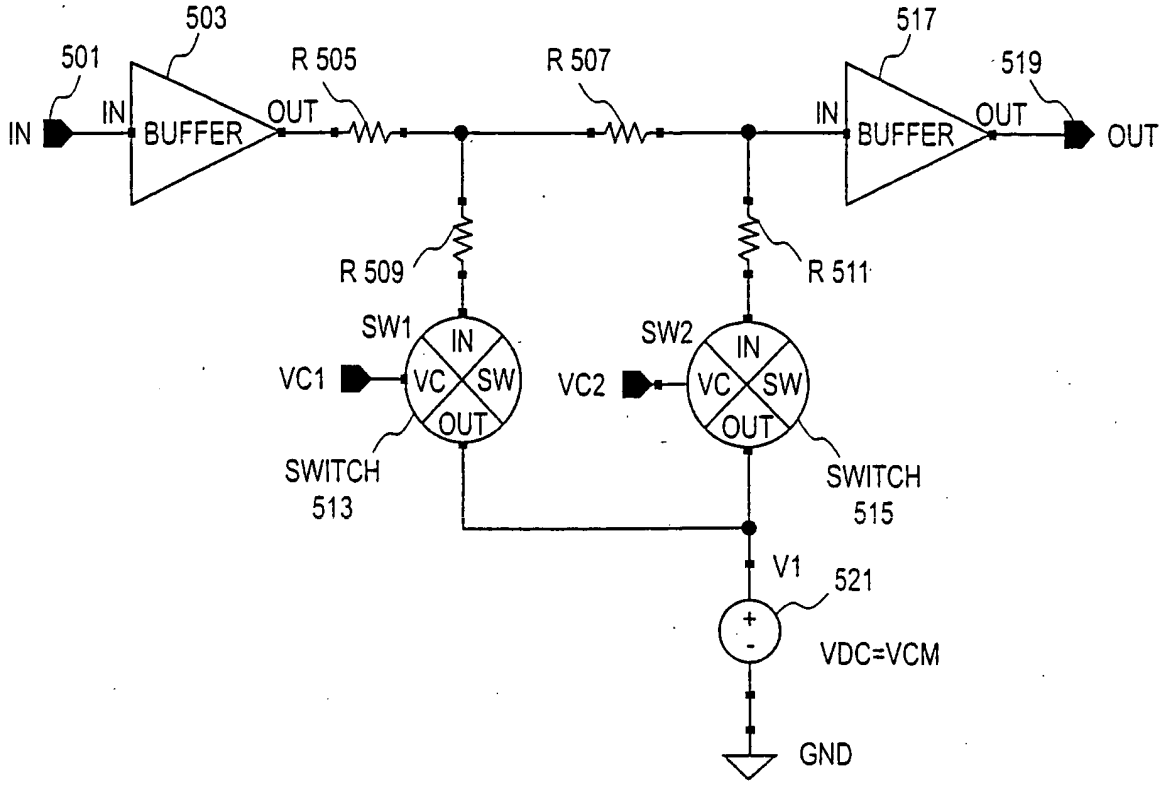

501
503
IN
IN
BUFFER
OUT
R 505
R 507
517
519
IN
BUFFER
OUT
OUT
R 509
R 511
SW1
SW2
IN
VC
SW
OUT
VC1
VC2
SWITCH
513
SWITCH
515
V1
521
+
-
VDC=VCM
GND

FIG. 6

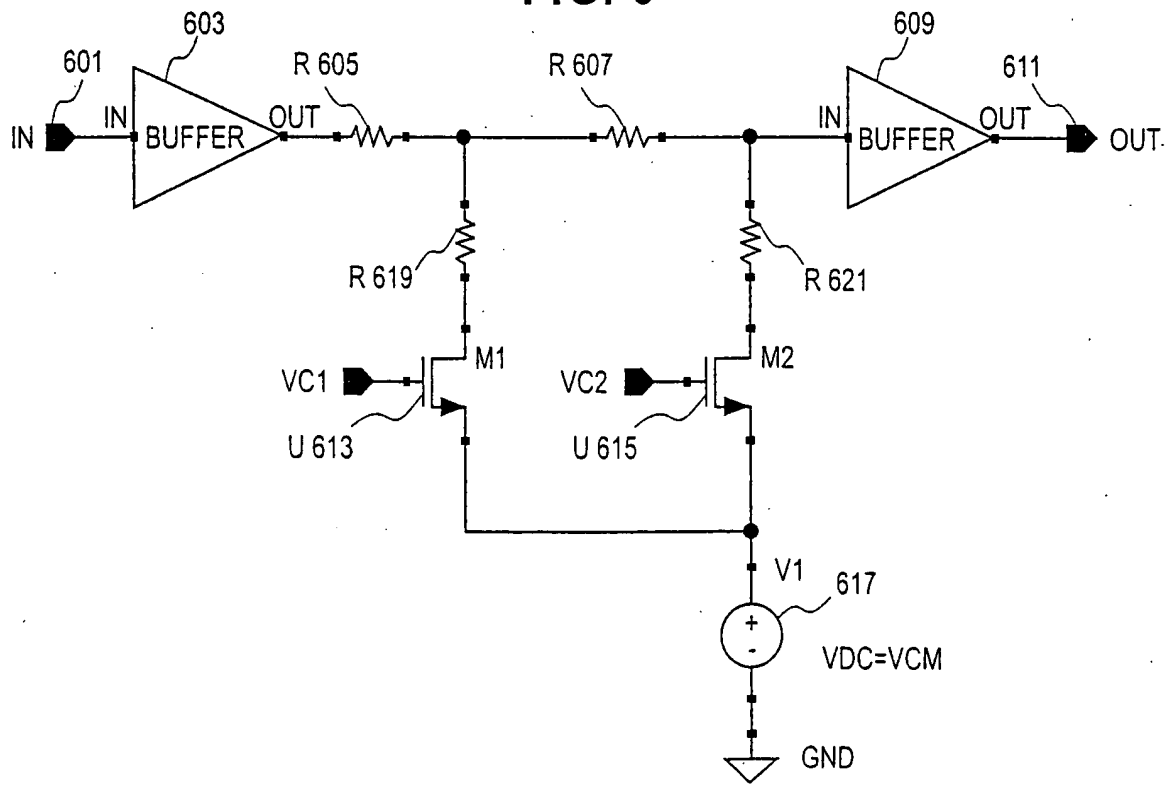

601
603
IN
IN
BUFFER
OUT
R 605
R 607
609
611
IN
BUFFER
OUT
OUT
R 619
R 621
M1
M2
VC1
VC2
U 613
U 615
V1
617
+
-
VDC=VCM
GND

FIG. 7

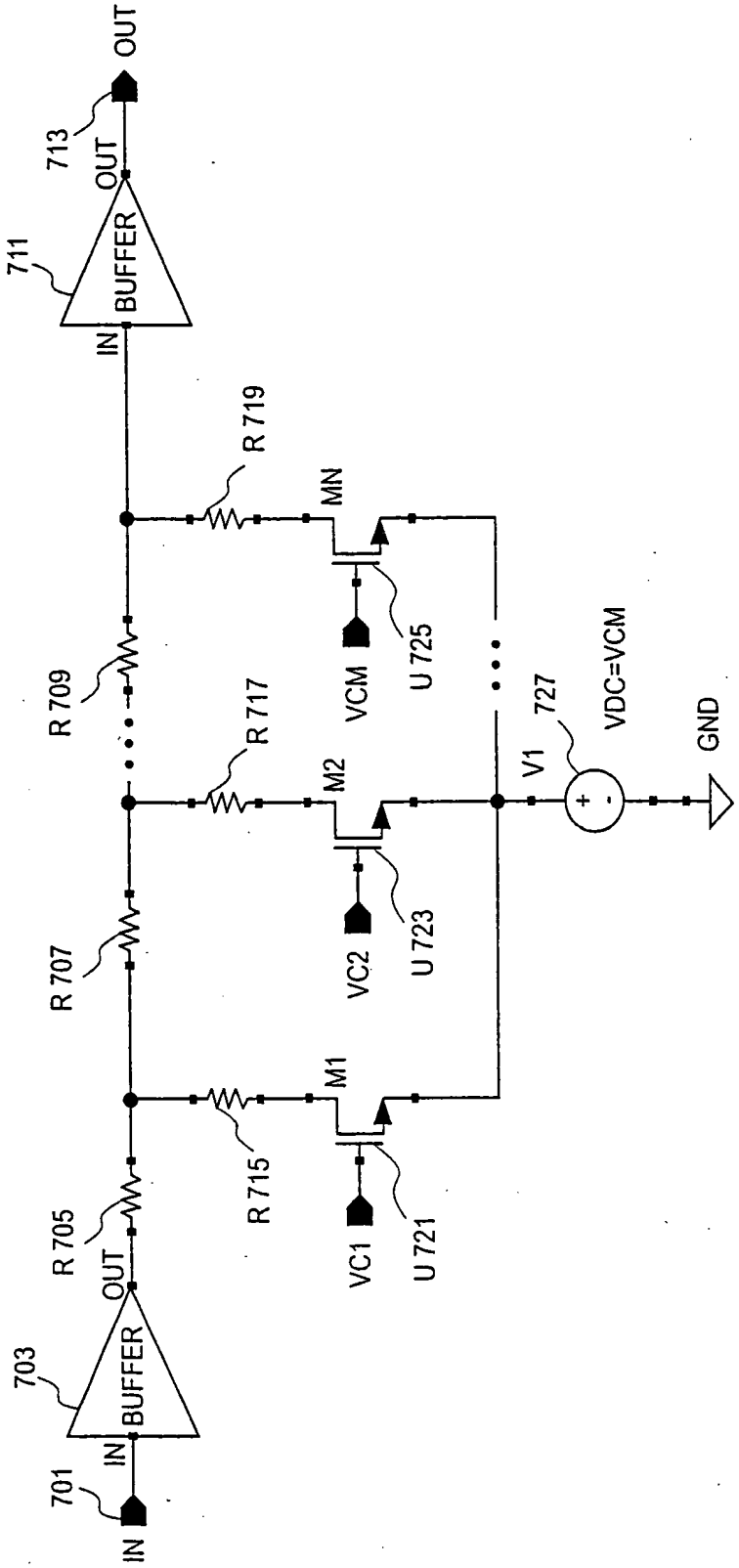

OUT
713
OUT
711
BUFFER
IN
R 719
MN
R 709
VCM
U 725
R 717
M2
V1
727
VDC=VCM
GND
R 707
VC2
U 723
M1
R 715
R 705
VC1
U 721
OUT
703
BUFFER
IN
701
IN

FIG.8

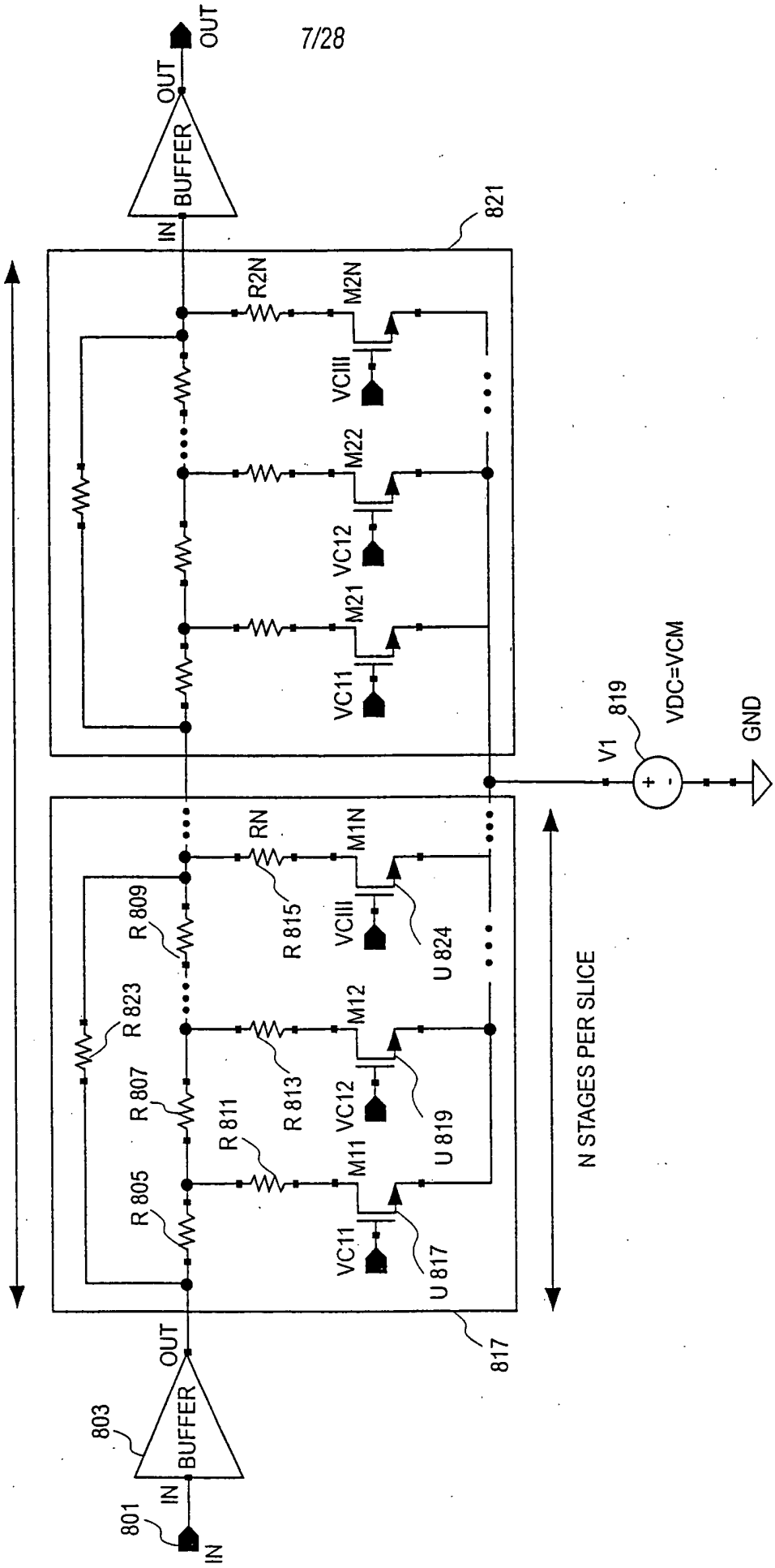

OUT
OUT
BUFFER
IN
821
R2N
M2N
VCIII
M22
VC12
M21
VC11
V1
819
VDC=VCM
GND
J SLICES
RN
M1N
R 809
R 815
VCIII
U 824
R 823
M12
R 807
R 813
VC12
U 819
R 811
M11
R 805
VC11
U 817
N STAGES PER SLICE
817
OUT
BUFFER
803
IN
801
IN

FIG. 9
PRIOR ART

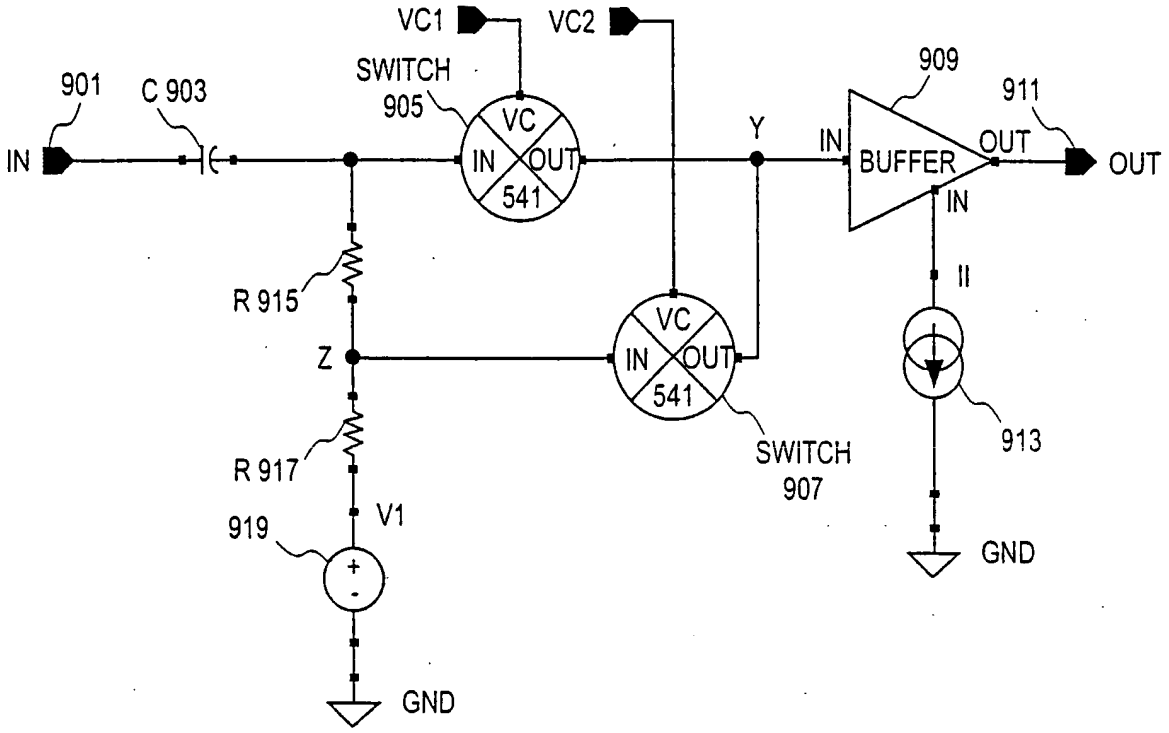


FIG.10
PRIOR ART

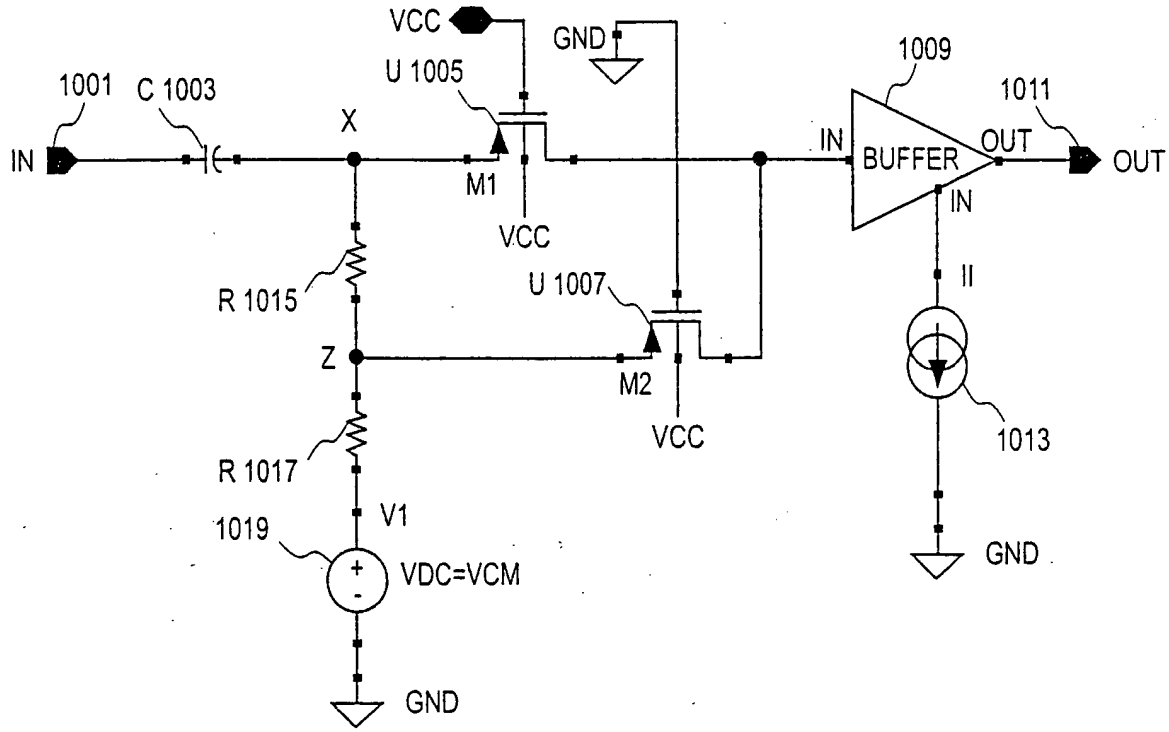


FIG. 11

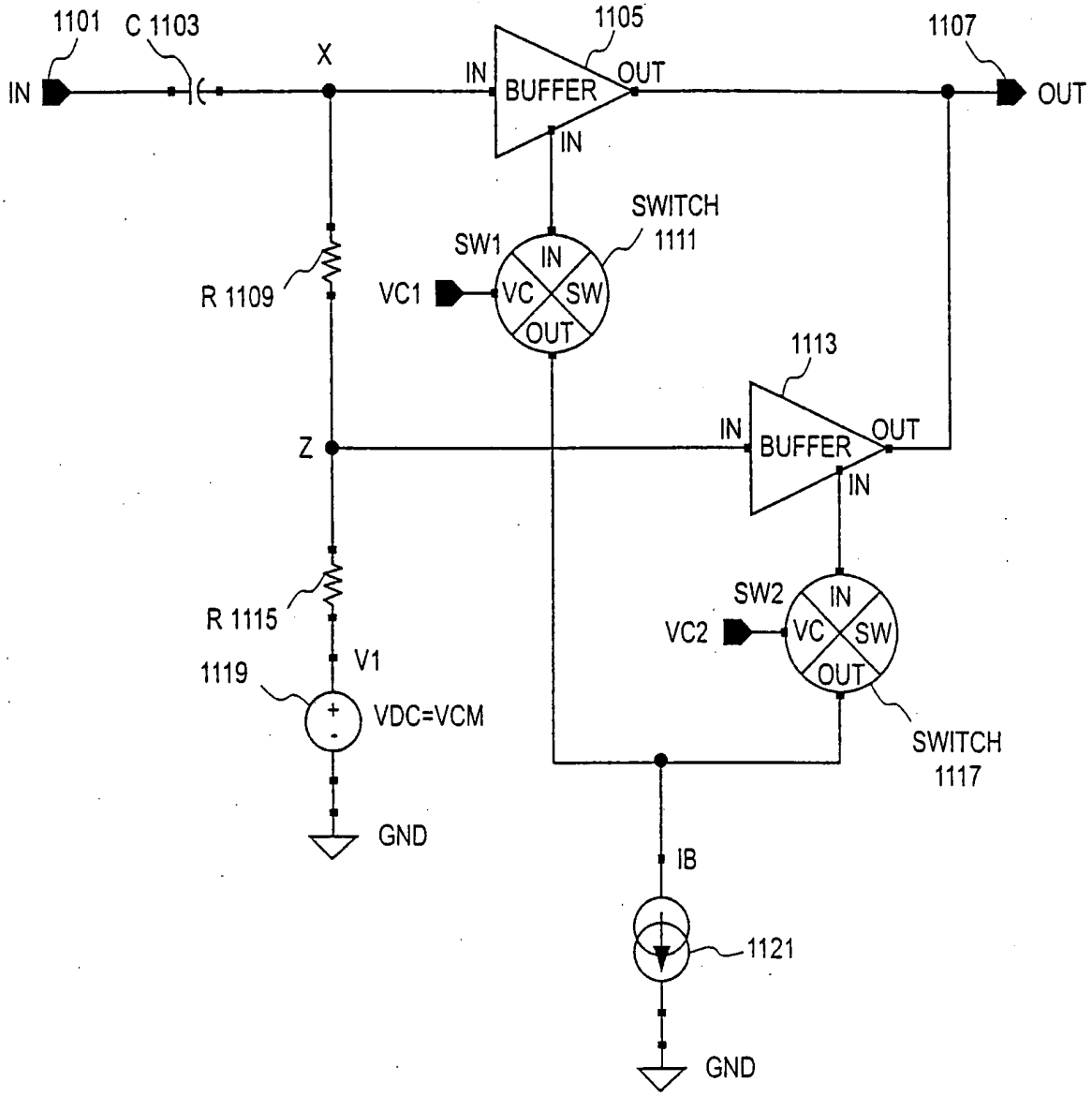

1101
C 1103
X
1105
1107
IN
BUFFER
OUT
IN
OUT
IN
SWITCH
1111
SW1
IN
VC
SW
OUT
VC1
R 1109
1113
Z
IN
BUFFER
OUT
IN
R 1115
SW2
IN
VC
SW
OUT
VC2
V1
1119
VDC=VCM
SWITCH
1117
GND
IB
1121
GND

FIG. 12

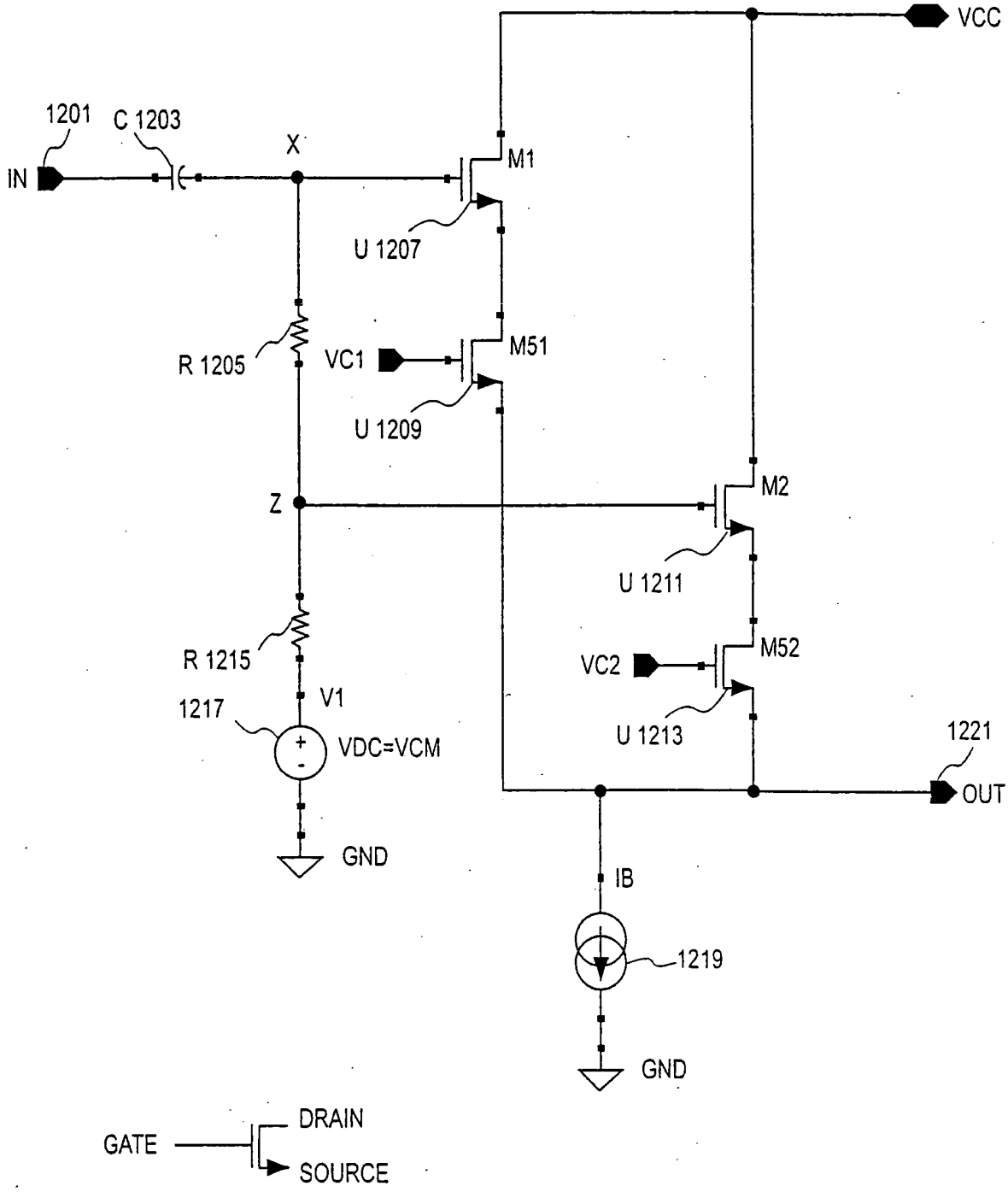
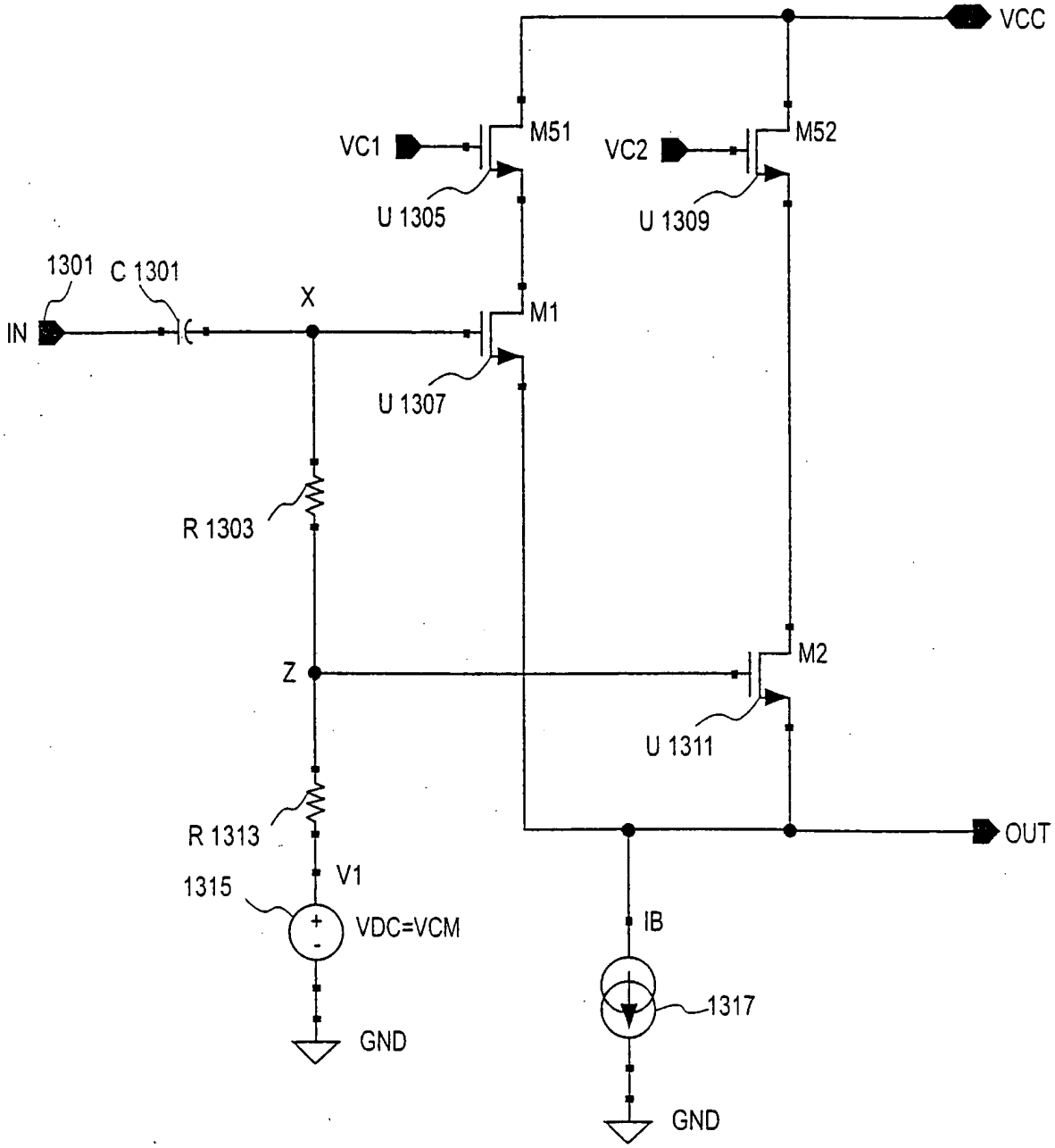

VCC
1201
C 1203
X
IN
M1
U 1207
R 1205
VC1
M51
U 1209
Z
M2
U 1211
R 1215
VC2
M52
1217
V1
VDC=VCM
U 1213
1221
OUT
GND
IB
1219
GND
DRAIN
GATE
SOURCE

FIG. 13


VCC
VC1
M51
U 1305
VC2
M52
U 1309
1301
C 1301
IN
X
M1
U 1307
R 1303
Z
M2
U 1311
R 1313
OUT
1315
V1
VDC=VCM
IB
1317
GND
GND

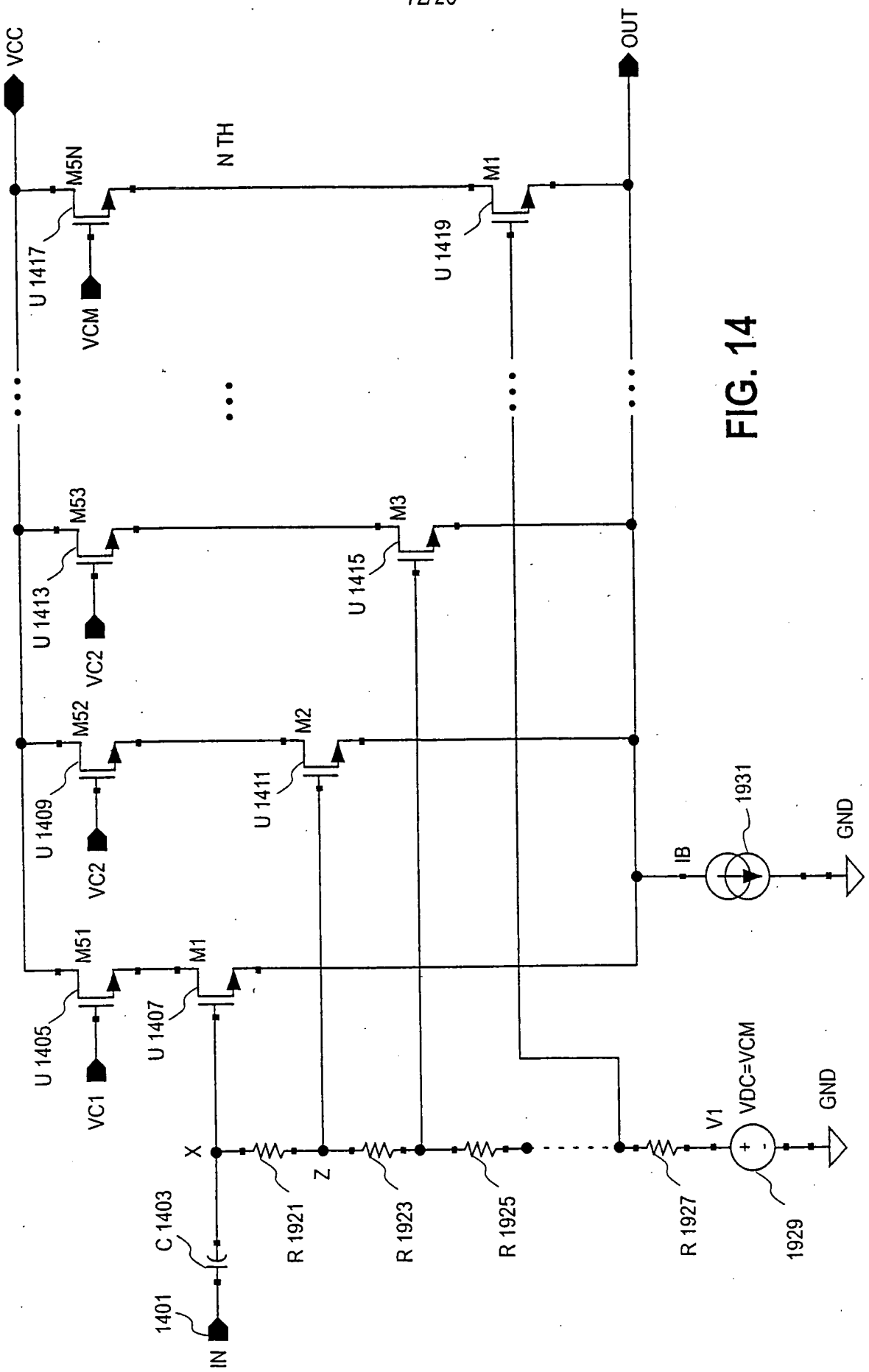

VCC
OUT
N TH
M5N
M1
U 1417
U 1419
VCM
M53
M3
U 1413
U 1415
VC2
M52
M2
U 1409
U 1411
VC2
M51
M1
U 1405
U 1407
VC1
IB
1931
GND
X
Z
V1
VDC=VCM
GND
C 1403
R 1921
R 1923
R 1925
R 1927
1929
1401
IN

FIG. 14

FIG. 15

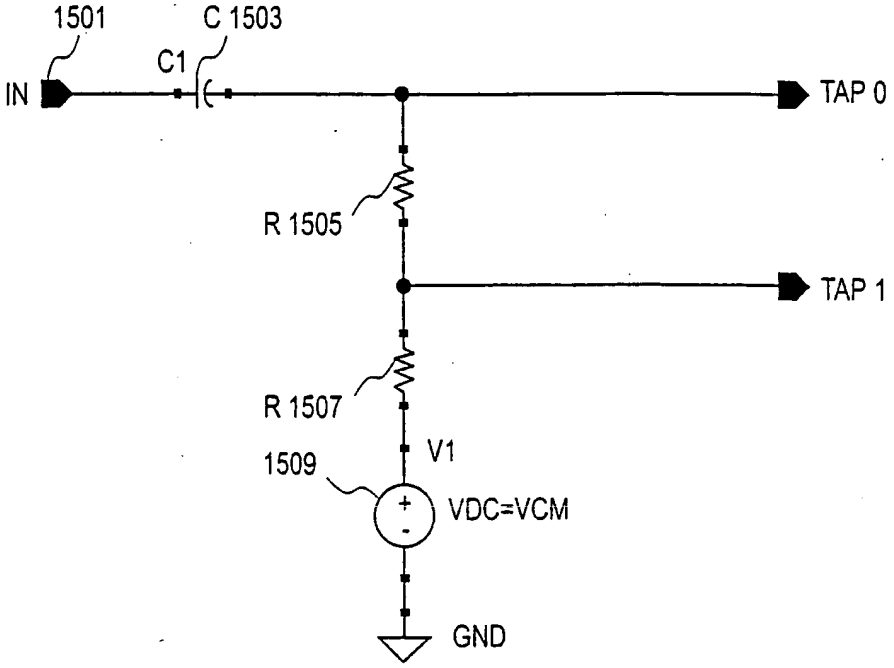

1501
C 1503
C1
IN
TAP 0
R 1505
TAP 1
R 1507
V1
1509
VDC=VCM
GND

FIG. 16

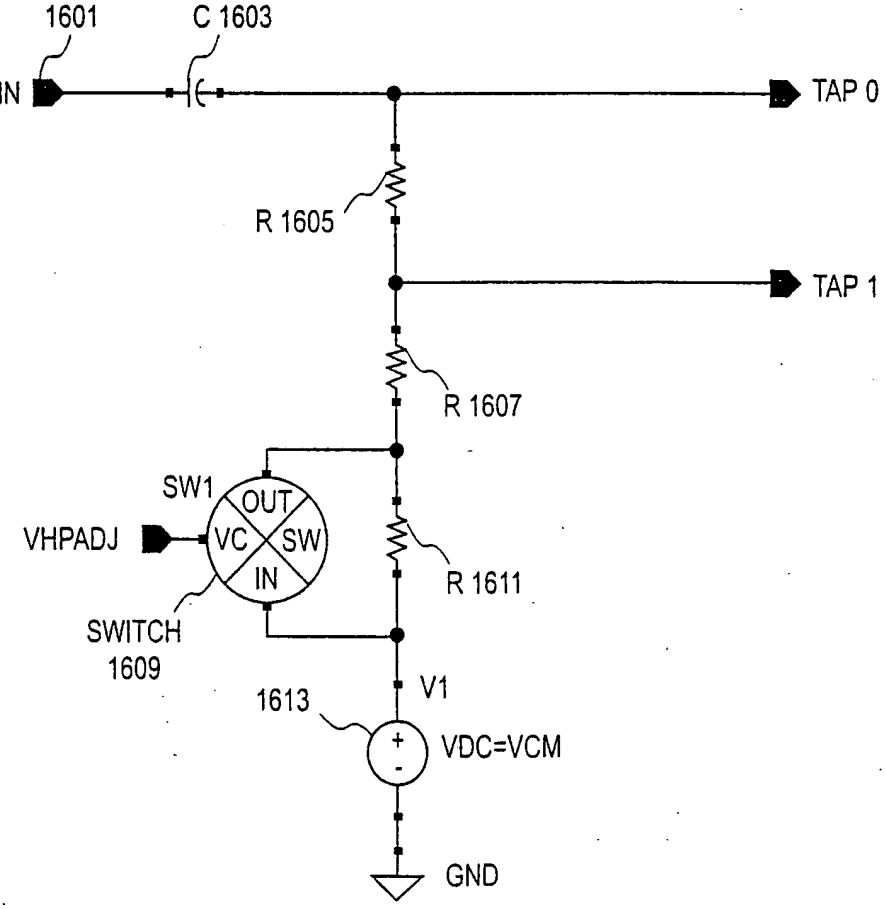

1601
C 1603
IN
TAP 0
R 1605
TAP 1
R 1607
SW1
OUT
VC
SW
IN
VHPADJ
SWITCH
1609
R 1611
V1
1613
VDC=VCM
GND

FIG. 17

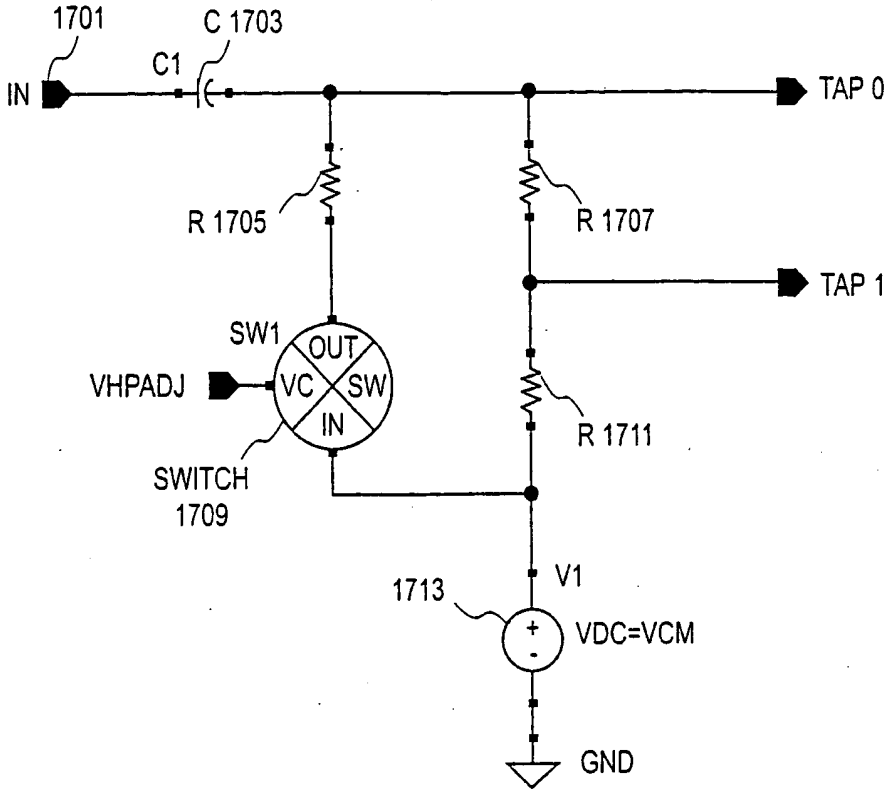

1701
C 1703
C1
IN
TAP 0
R 1705
R 1707
TAP 1
SW1
OUT
VHPADJ
VC
SW
IN
R 1711
SWITCH
1709
V1
1713
VDC=VCM
GND

FIG. 18

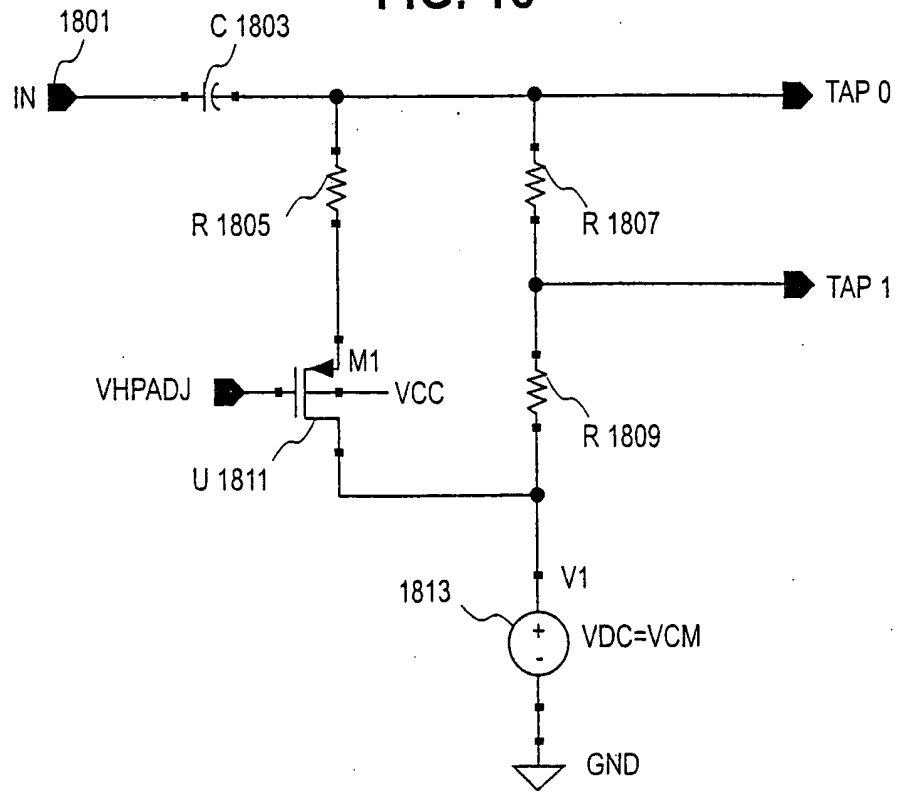

1801
C 1803
IN
TAP 0
R 1805
R 1807
TAP 1
M1
VHPADJ
VCC
R 1809
U 1811
V1
1813
VDC=VCM
GND

FIG. 19

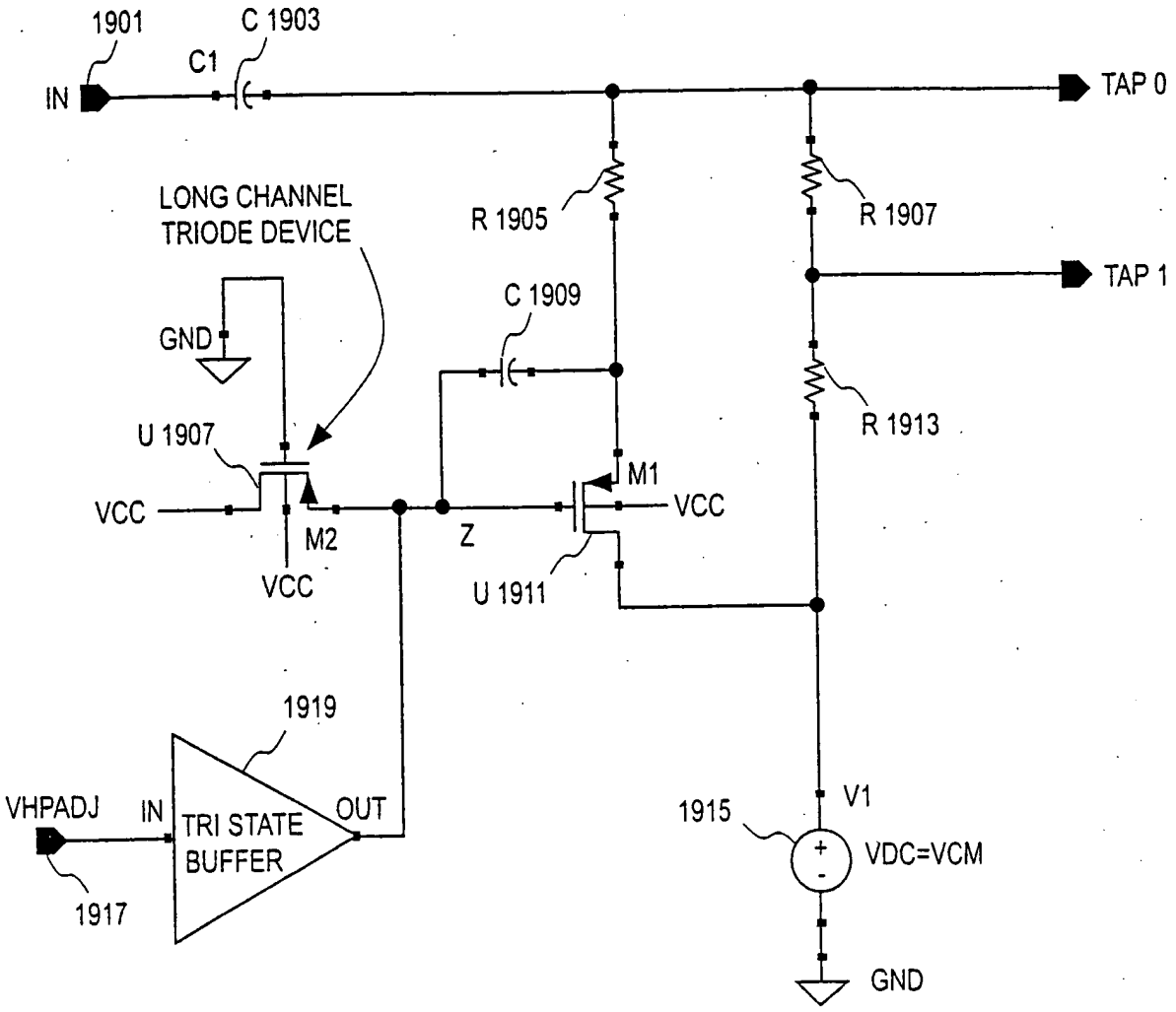
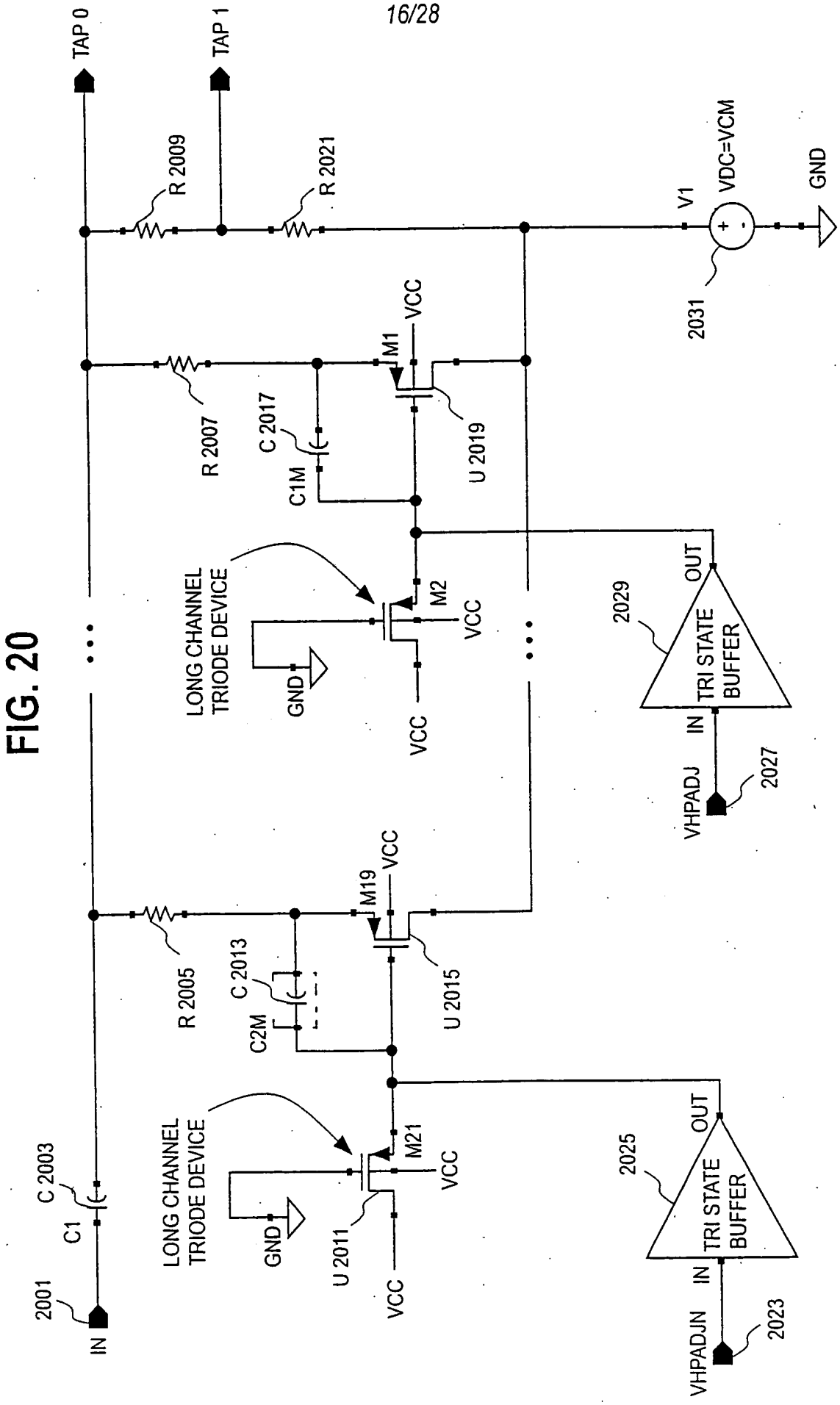

1901
C 1903
C1
IN
TAP 0
LONG CHANNEL
TRIODE DEVICE
R 1905
R 1907
TAP 1
GND
C 1909
U 1907
R 1913
M1
VCC
VCC
M2
Z
VCC
U 1911
1919
VHPADJ
IN
TRI STATE
BUFFER
OUT
1915
V1
VDC=VCM
1917
GND

FIG. 20


TAP 0
TAP 1
R 2009
R 2021
V1
VDC=VCM
GND
2031
VCC
M1
R 2007
C 2017
C1M
U 2019
LONG CHANNEL TRIODE DEVICE
M2
VCC
GND
VCC
OUT
2029
TRI STATE BUFFER
IN
VHPADJ
2027
M19
VCC
R 2005
C 2013
C2M
U 2015
LONG CHANNEL TRIODE DEVICE
M21
VCC
GND
U 2011
VCC
C 2003
C1
2001
IN
OUT
2025
TRI STATE BUFFER
IN
VHPADJN
2023

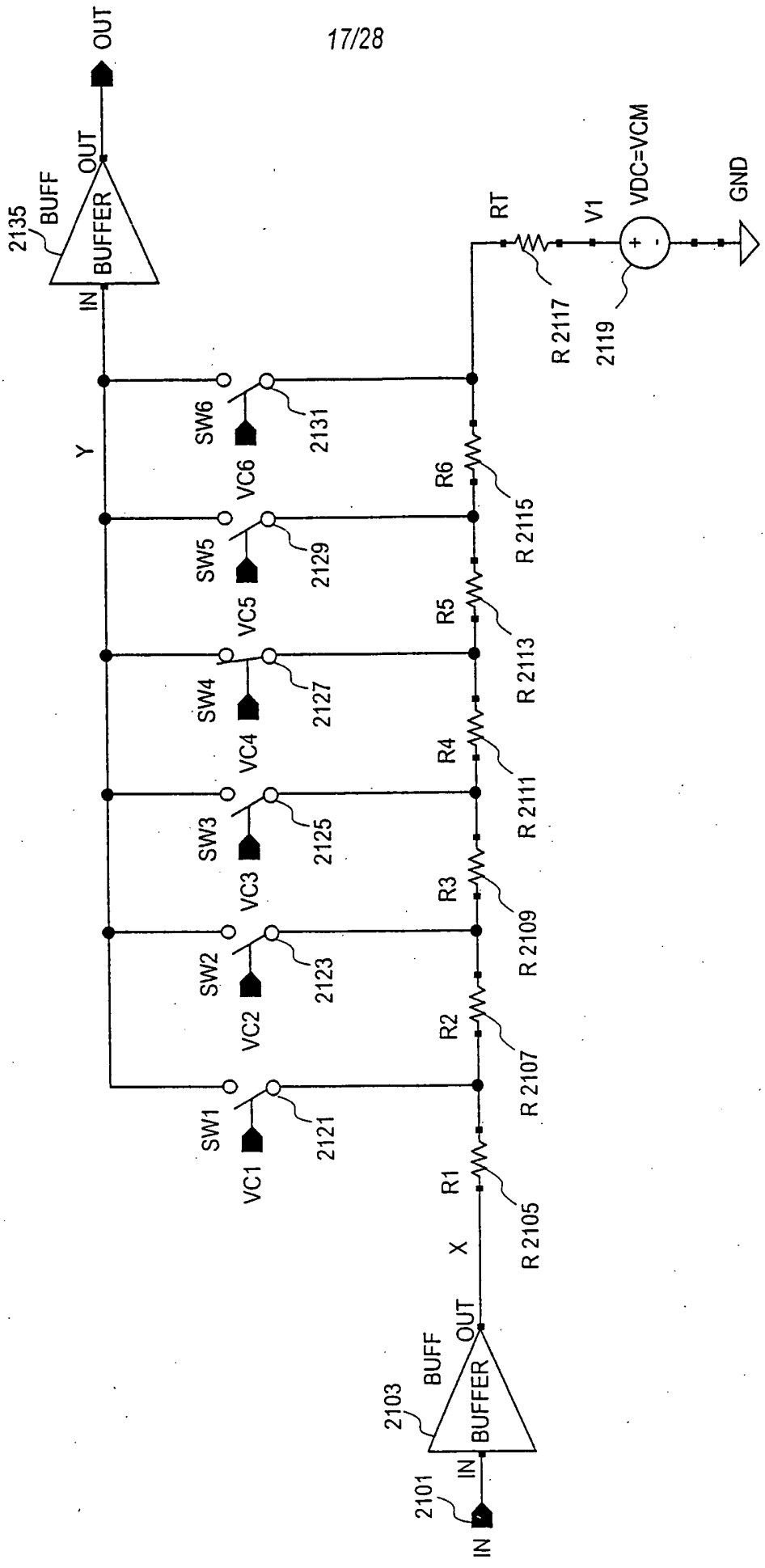


FIG. 21
PRIOR ART

FIG. 22

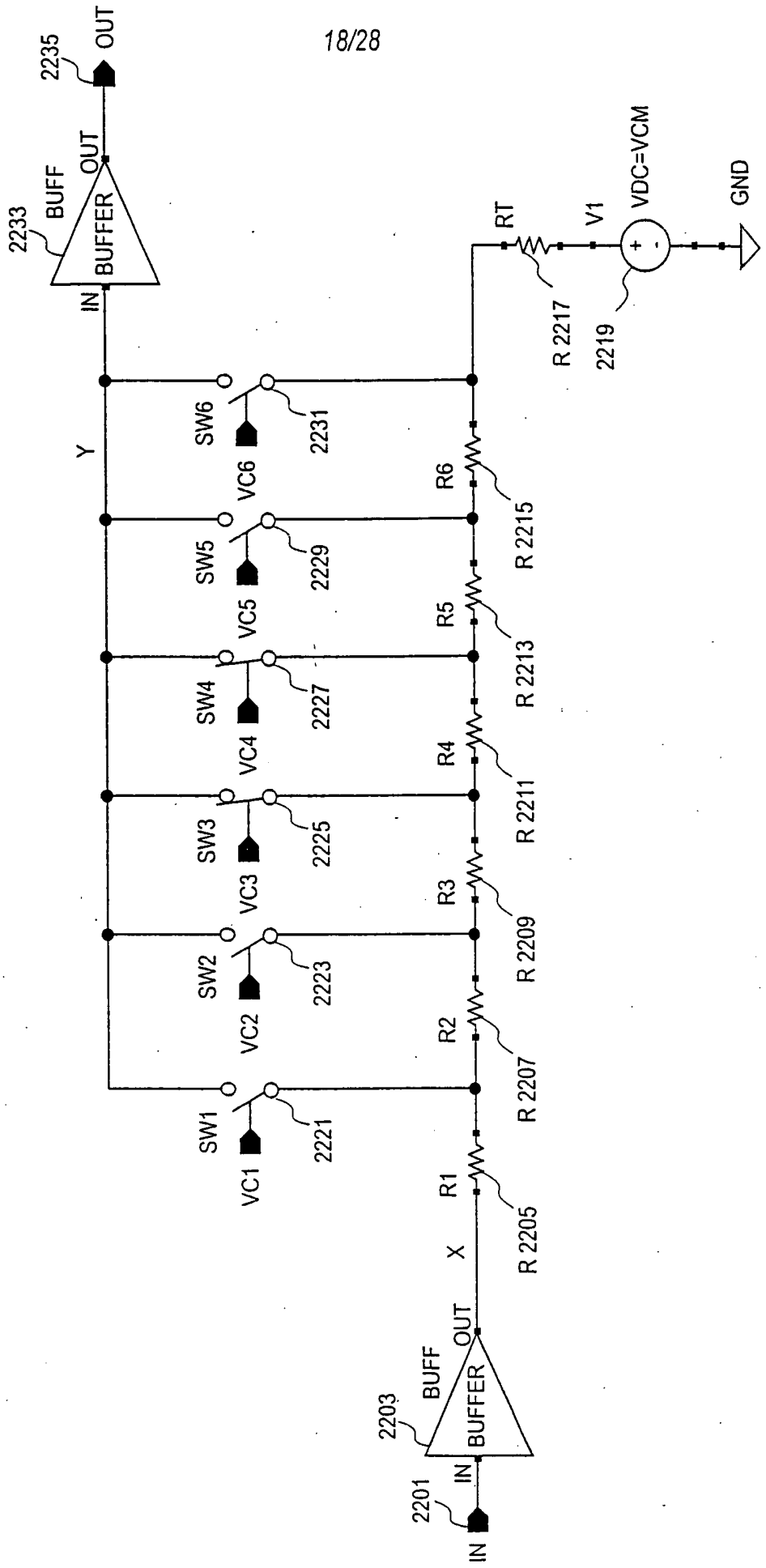

OUT
2235
OUT
BUFF
BUFFER
2233
IN
Y
SW6
VC6
2231
R6
R 2215
SW5
VC5
2229
R5
R 2213
SW4
VC4
2227
R4
R 2211
SW3
VC3
2225
R3
R 2209
SW2
VC2
2223
R2
R 2207
SW1
VC1
2221
R1
R 2205
X
OUT
BUFF
BUFFER
2203
IN
2201
IN
RT
V1
VDC=VCM
GND
R 2217
2219

FIG. 23

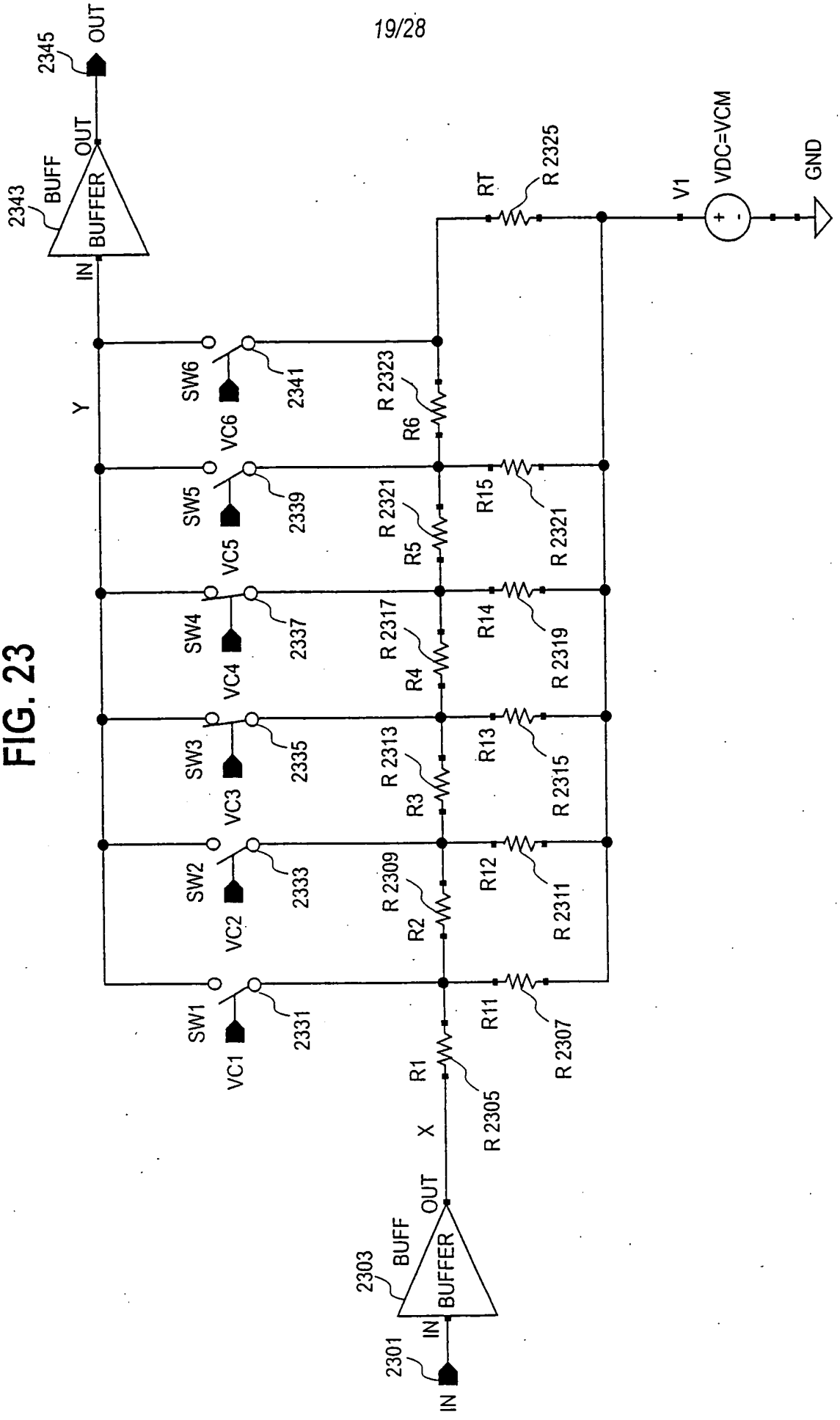

2345
OUT
2343
BUFF
BUFFER
IN
Y
SW6
VC6
2341
R 2323
R6
SW5
VC5
2339
R 2321
R5
R15
R 2321
SW4
VC4
2337
R 2317
R4
R14
R 2319
SW3
VC3
2335
R 2313
R3
R13
R 2315
SW2
VC2
2333
R 2309
R2
R12
R 2311
SW1
VC1
2331
R1
R11
R 2307
R 2305
X
2303
2301
RT
R 2325
V1
VDC=VCM
GND

FIG. 24

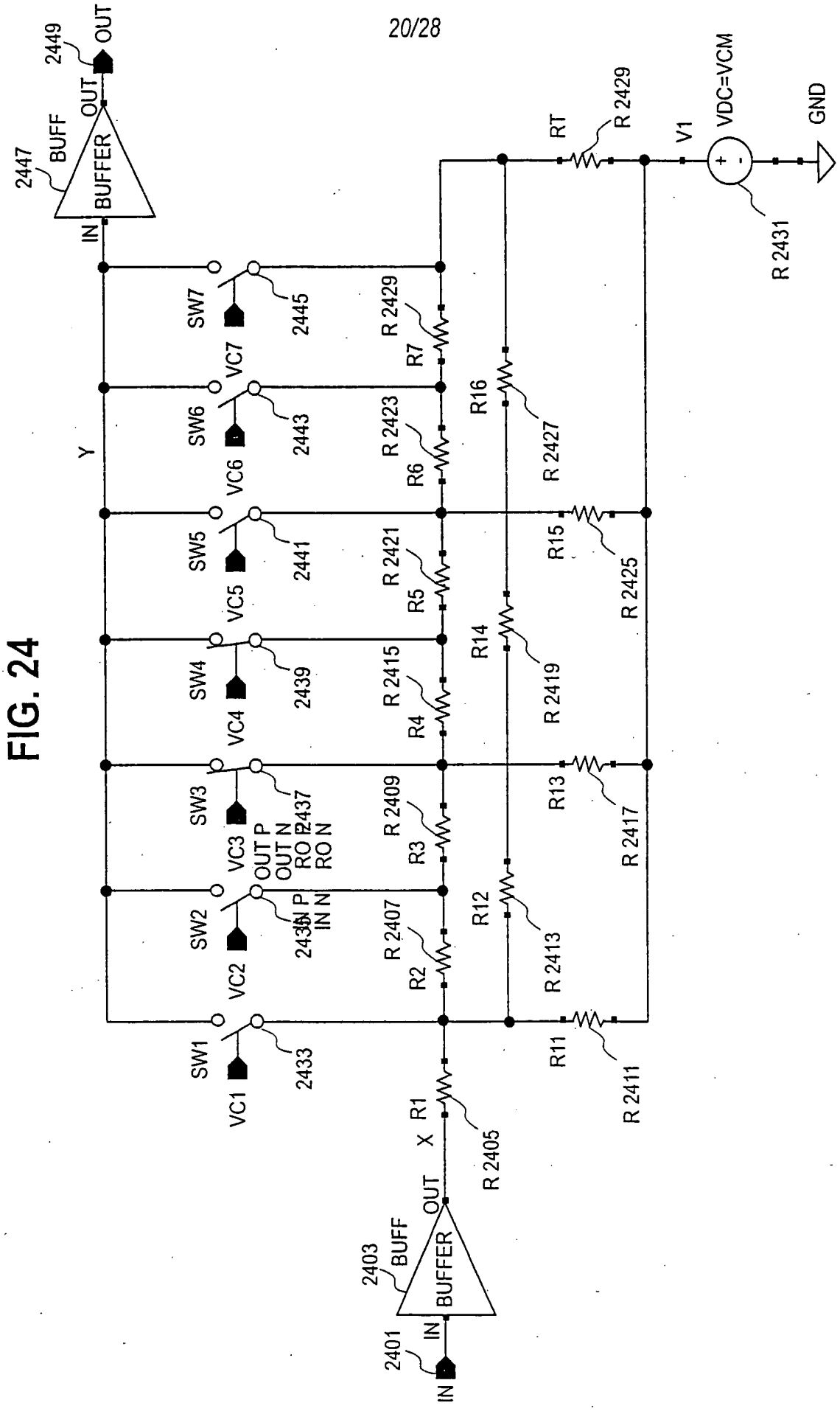

2449
OUT
OUT
2447
BUFF
BUFFER
IN
SW7
VC7
2445
R 2429
R7
SW6
VC6
2443
R 2423
R6
SW5
VC5
2441
R 2421
R5
SW4
VC4
2439
R 2415
R4
SW3
VC3
2437
OUT P
OUT N
RO P
RO N
R 2409
R3
SW2
VC2
2435
IN P
IN N
R 2407
R2
SW1
VC1
2433
R 2405
R1
X
Y
2403
BUFF
BUFFER
OUT
2401
IN
IN
R16
R 2427
R15
R 2425
R14
R 2419
R13
R 2417
R12
R 2413
R11
R 2411
RT
R 2429
V1
VDC=VCM
GND
R 2431

FIG. 25

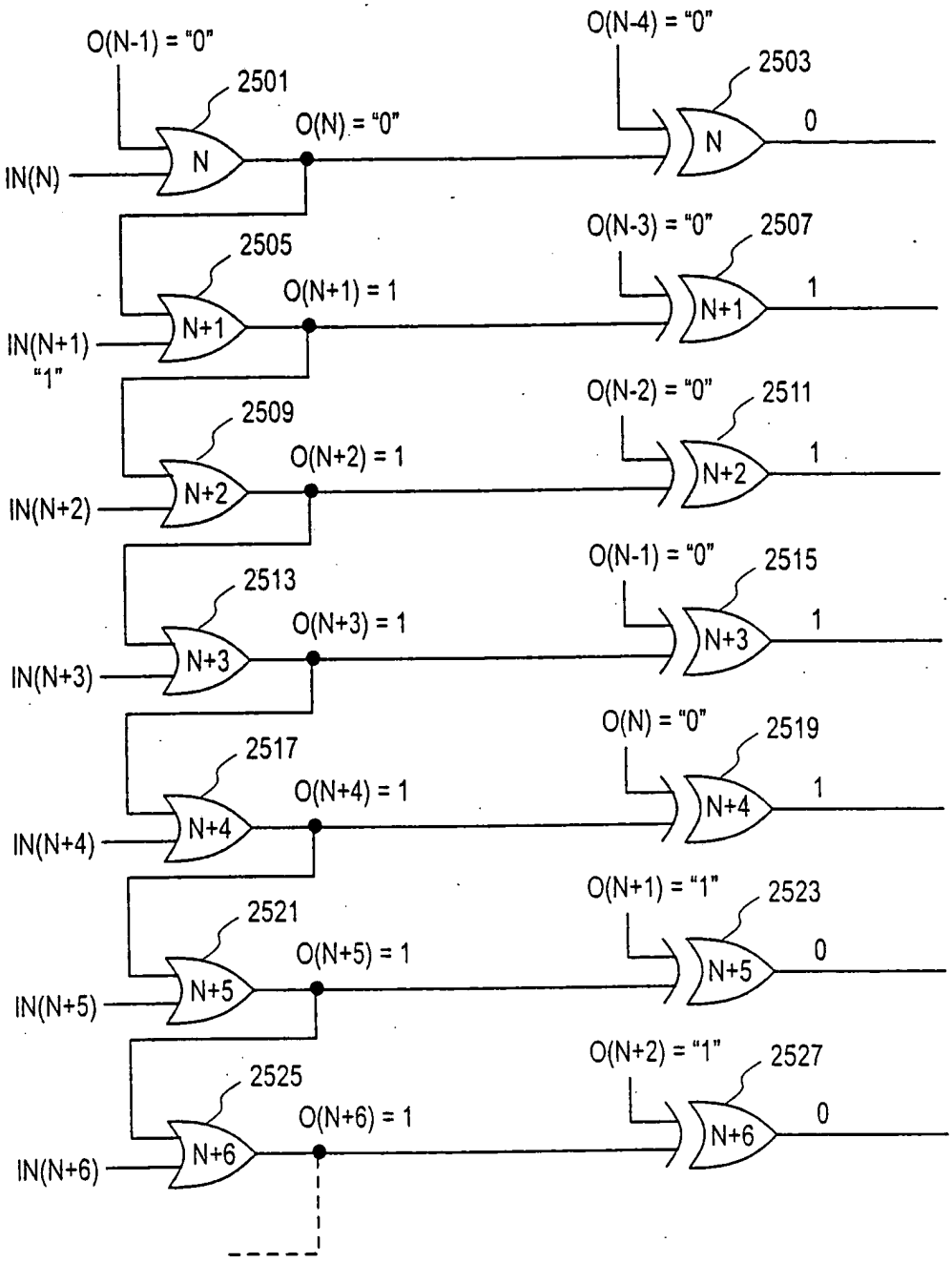

O(N-1) = "0"
2501
O(N) = "0"
N
IN(N)
O(N-4) = "0"
2503
N
0
2505
O(N+1) = 1
N+1
IN(N+1)
"1"
O(N-3) = "0"
2507
N+1
1
2509
O(N+2) = 1
N+2
IN(N+2)
O(N-2) = "0"
2511
N+2
1
2513
O(N+3) = 1
N+3
IN(N+3)
O(N-1) = "0"
2515
N+3
1
2517
O(N+4) = 1
N+4
IN(N+4)
O(N) = "0"
2519
N+4
1
2521
O(N+5) = 1
N+5
IN(N+5)
O(N+1) = "1"
2523
N+5
0
2525
O(N+6) = 1
N+6
IN(N+6)
O(N+2) = "1"
2527
N+6
0

FIG. 26

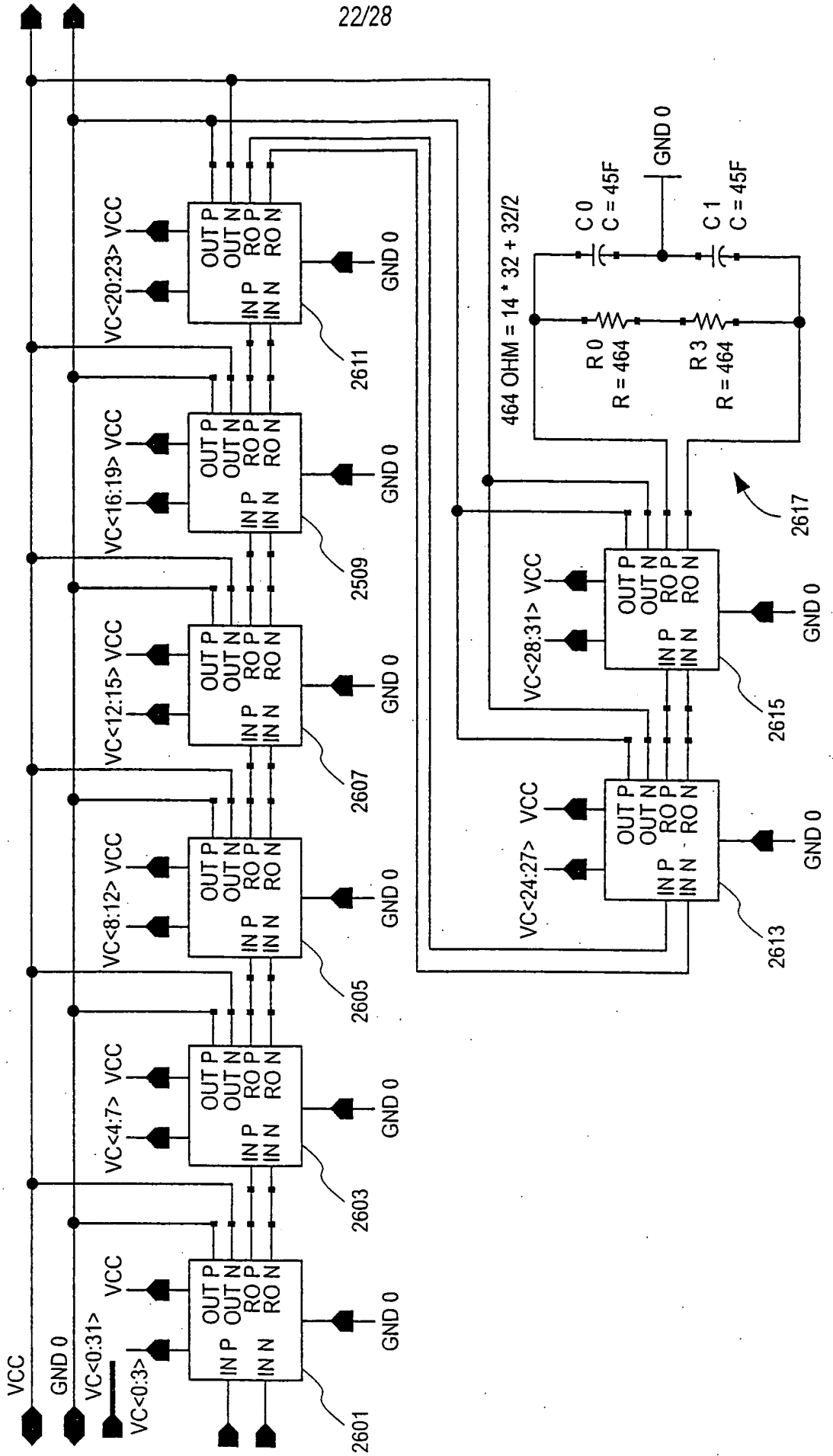

VCC
GND 0
VC<0:31>
VC<0:3>
VC<4:7>
VC<8:12>
VC<12:15>
VC<16:19>
VC<20:23>
VC<24:27>
VC<28:31>
OUT P
OUT N
RO P
RO N
IN P
IN N
2601
2603
2605
2607
2509
2611
2613
2615
2617
464 OHM = 14 * 32 + 32/2
R 0
R = 464
R 3
R = 464
C 0
C = 45F
C 1
C = 45F

FIG. 27

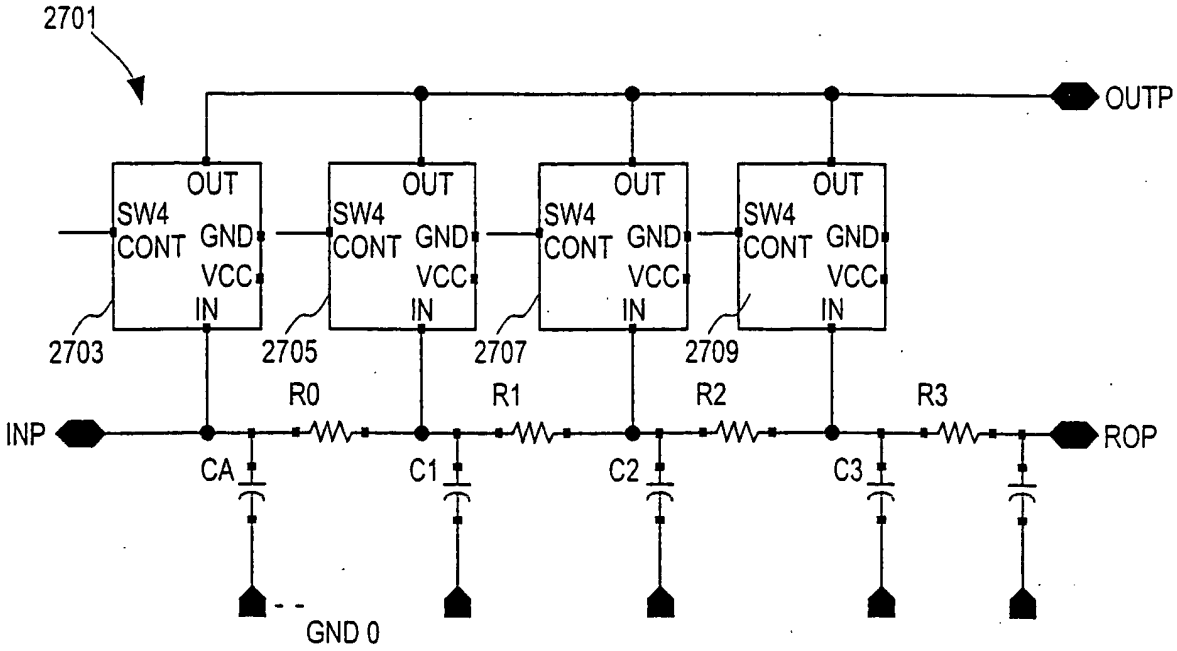

2701
OUTP
OUT
SW4
CONT
GND
VCC
IN
2703
2705
2707
2709
R0
R1
R2
R3
INP
ROP
CA
C1
C2
C3
GND 0

FIG. 28

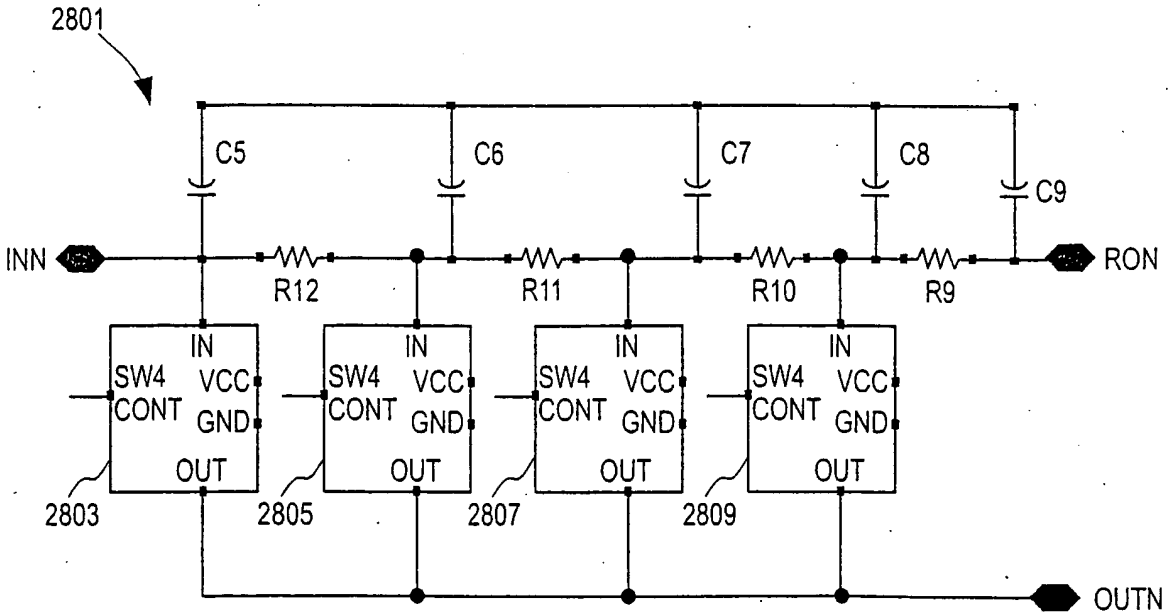

2801
C5
C6
C7
C8
C9
INN
RON
R12
R11
R10
R9
IN
SW4
CONT
VCC
GND
OUT
2803
2805
2807
2809
OUTN

FIG. 29

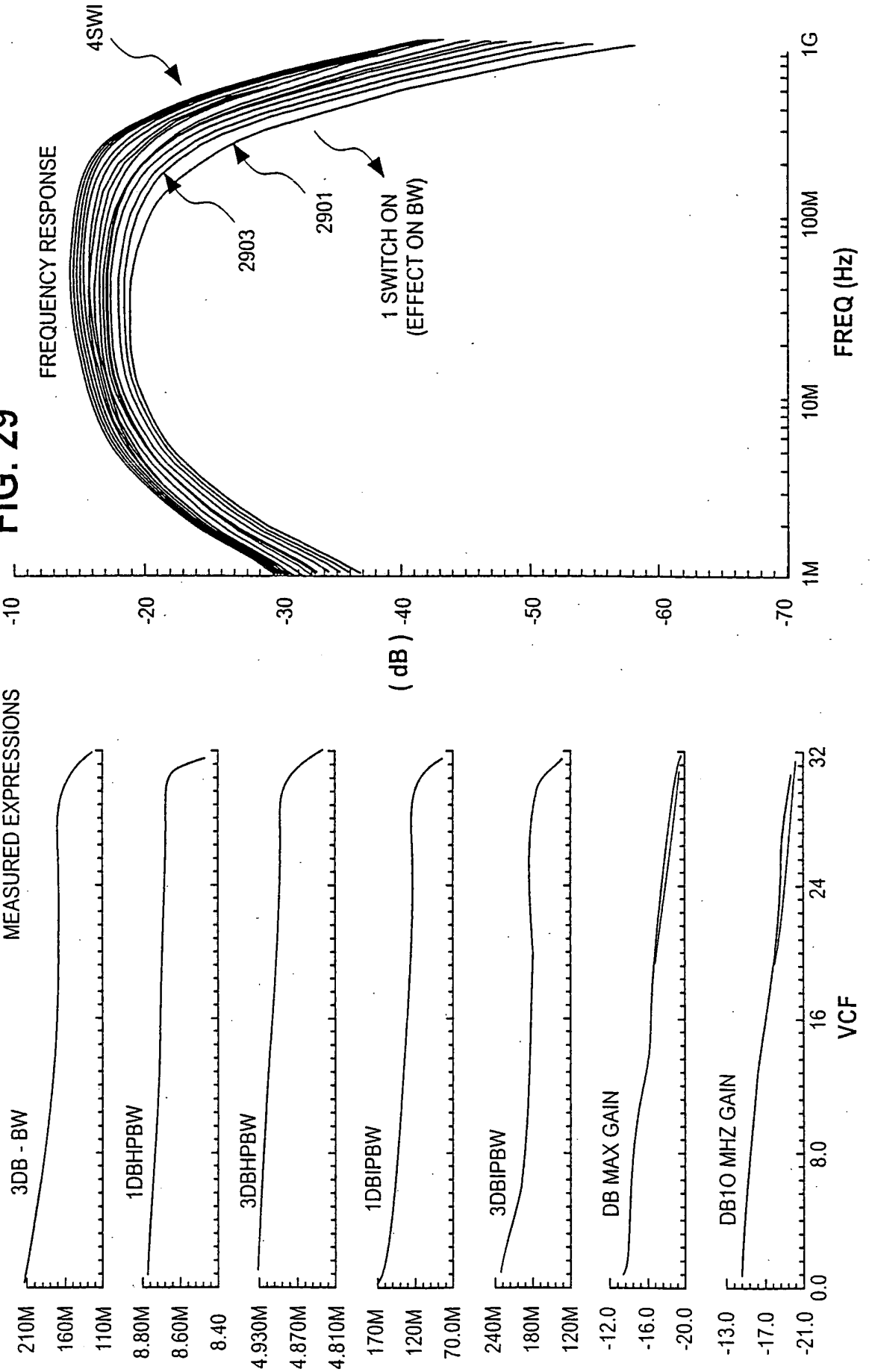

FREQUENCY RESPONSE
4SWI
2903
2901
1 SWITCH ON
(EFFECT ON BW)
-10
-20
-30
-40
-50
-60
-70
(dB)
1M
10M
100M
1G
FREQ (Hz)
MEASURED EXPRESSIONS
3DB - BW
1DBHPBW
3DBHPBW
1DBIPBW
3DBIPBW
DB MAX GAIN
DB1O MHZ GAIN
210M
160M
110M
8.80M
8.60M
8.40
4.930M
4.870M
4.810M
170M
120M
70.0M
240M
180M
120M
-12.0
-16.0
-20.0
-13.0
-17.0
-21.0
0.0
8.0
16
24
32
VCF

FIG. 30

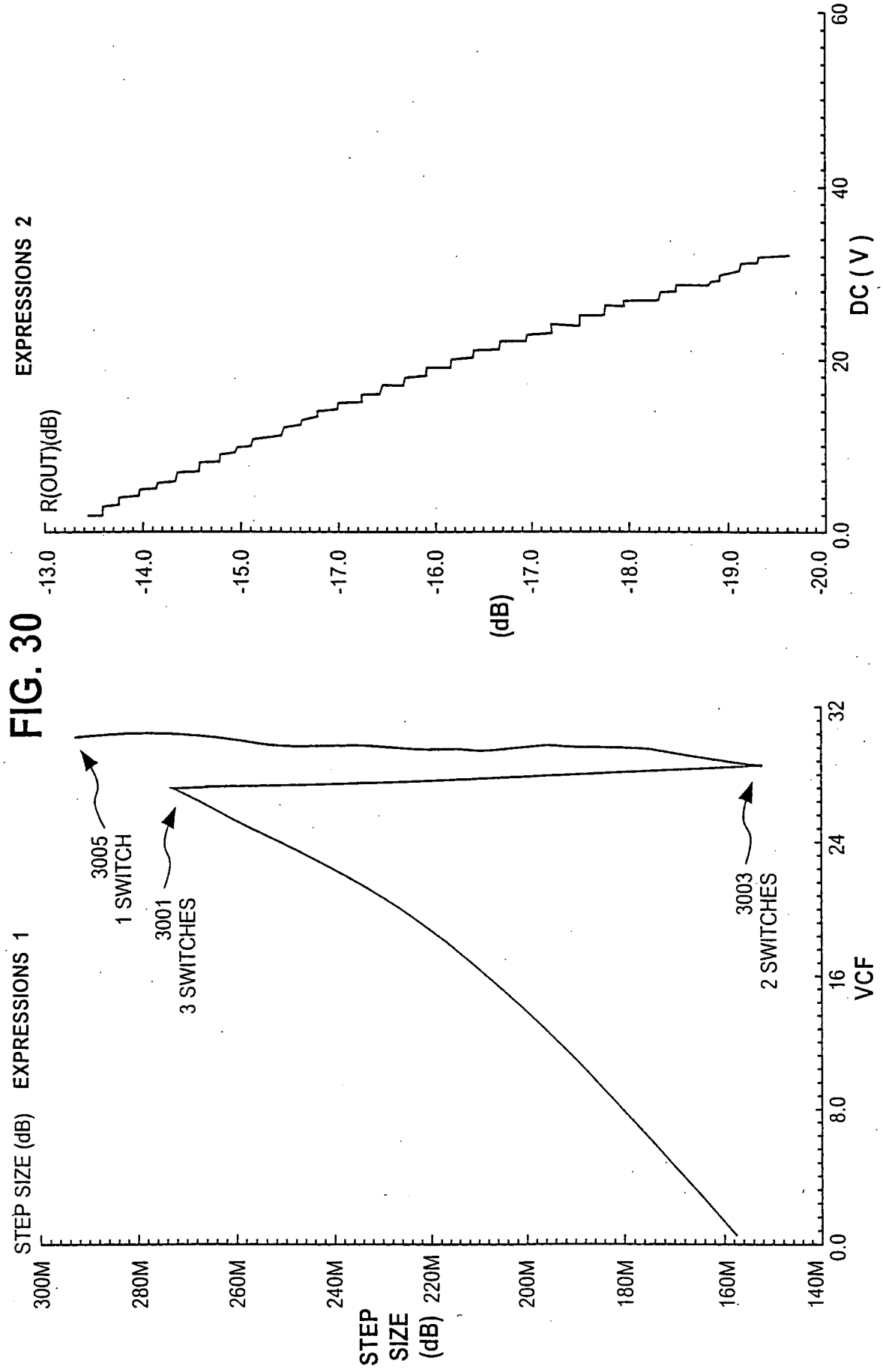

STEP SIZE (dB) EXPRESSIONS 1
300M
280M
260M
240M
220M
200M
180M
160M
140M
STEP SIZE (dB)
0.0
8.0
16
24
32
VCF
3005
1 SWITCH
3001
3 SWITCHES
3003
2 SWITCHES
EXPRESSIONS 2
R(OUT)(dB)
-13.0
-14.0
-15.0
-17.0
-16.0
-17.0
-18.0
-19.0
-20.0
(dB)
0.0
20
40
60
DC (V)

FIG. 31

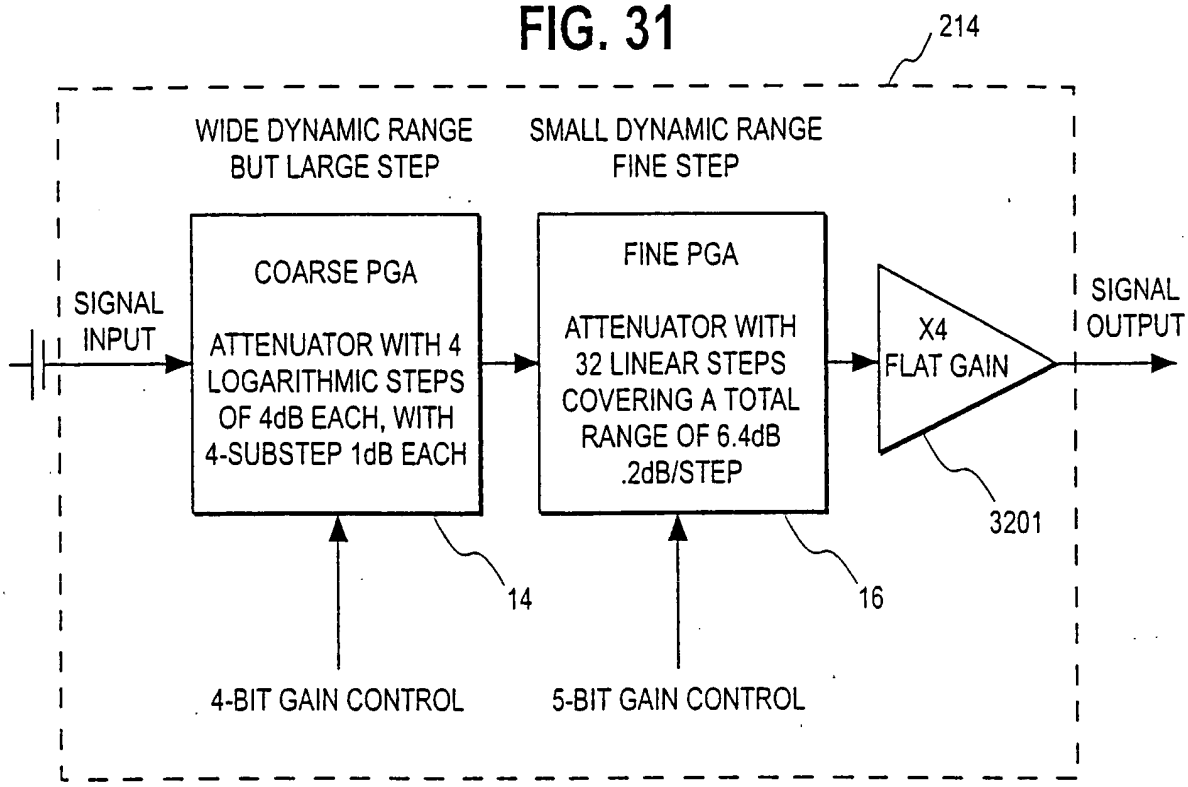

214
WIDE DYNAMIC RANGE
BUT LARGE STEP
SMALL DYNAMIC RANGE
FINE STEP
SIGNAL
INPUT
COARSE PGA
ATTENUATOR WITH 4
LOGARITHMIC STEPS
OF 4dB EACH, WITH
4-SUBSTEP 1dB EACH
FINE PGA
ATTENUATOR WITH
32 LINEAR STEPS
COVERING A TOTAL
RANGE OF 6.4dB
.2dB/STEP
X4
FLAT GAIN
SIGNAL
OUTPUT
3201
14
16
4-BIT GAIN CONTROL
5-BIT GAIN CONTROL

FIG. 32

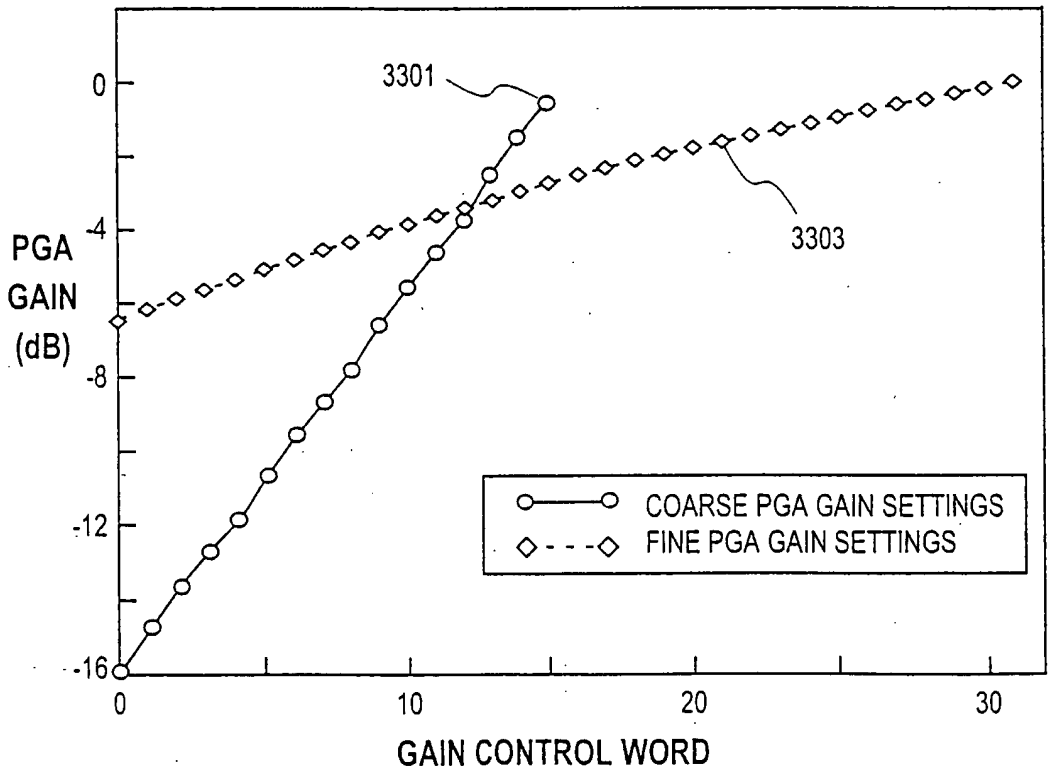

3301
3303
0
-4
-8
-12
-16
PGA
GAIN
(dB)
COARSE PGA GAIN SETTINGS
FINE PGA GAIN SETTINGS
0
10
20
30
GAIN CONTROL WORD

FIG. 33

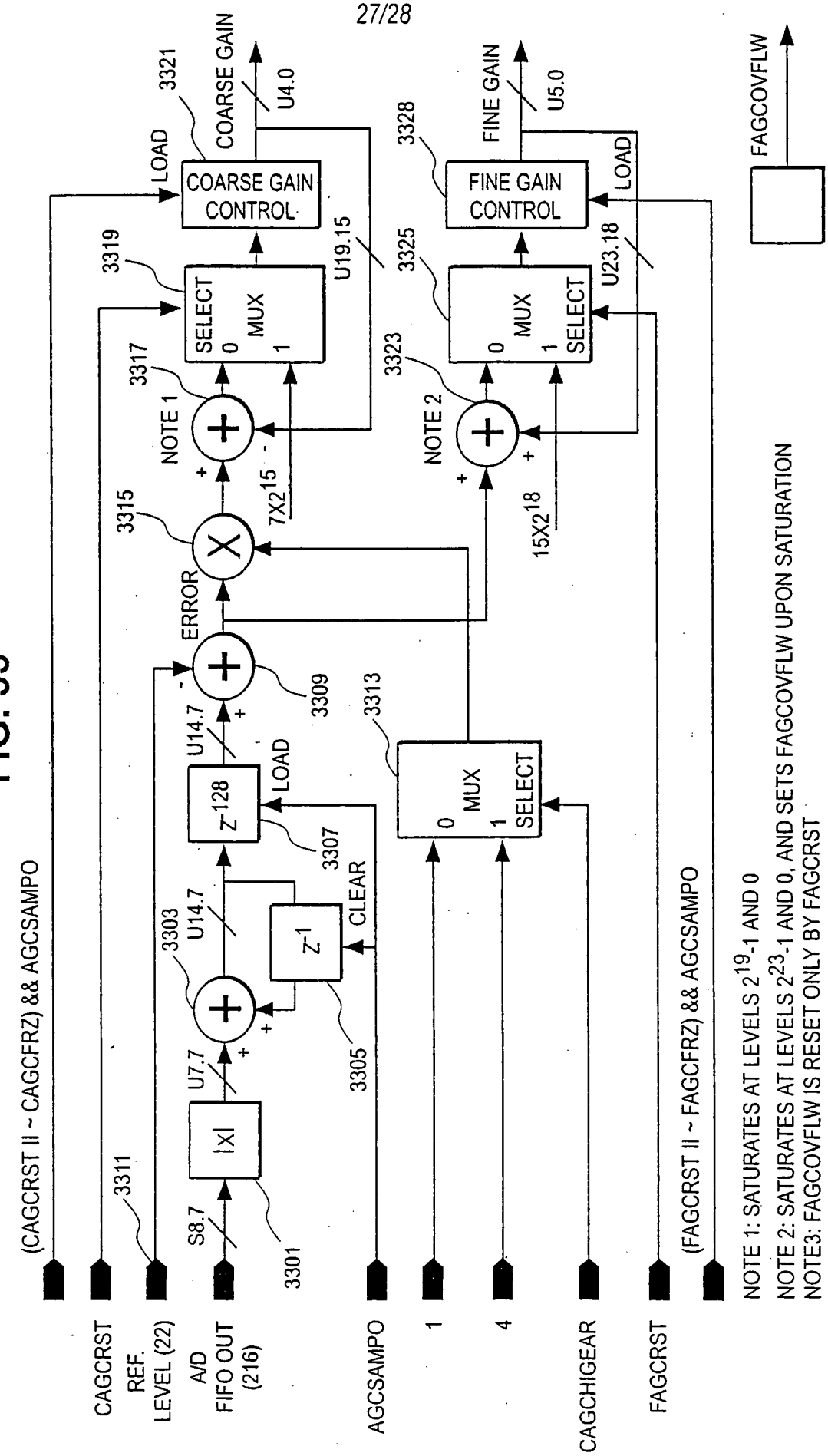

(CAGCRST II ~ CAGCFRZ) && AGCSAMPO
CAGCRST
REF. LEVEL (22)
A/D FIFO OUT (216)
AGCSAMPO
1
4
CAGCHIGEAR
FAGCRST
(FAGCRST II ~ FAGCFRZ) && AGCSAMPO
FAGCOVFLW
3311
3301
S8.7
|X|
U7.7
3303
U14.7
3305
CLEAR
Z-1
Z-128
LOAD
3307
U14.7
3309
ERROR
3315
7X2^15
NOTE 1
3317
3319
SELECT
MUX
U19.15
LOAD
COARSE GAIN CONTROL
3321
COARSE GAIN
U4.0
3313
MUX
SELECT
3323
15X2^18
NOTE 2
3325
MUX
SELECT
U23.18
3328
FINE GAIN CONTROL
LOAD
FINE GAIN
U5.0
NOTE 1: SATURATES AT LEVELS 2^19-1 AND 0
NOTE 2: SATURATES AT LEVELS 2^23-1 AND 0, AND SETS FAGCOVFLW UPON SATURATION
NOTE3: FAGCOVFLW IS RESET ONLY BY FAGCRST

FIG. 34

CABLE LENGTH (m)	100 BASE-TX	GIGABIT, 100 OHM	GIGABIT, 85 OHM	GIGABIT, 115 OHM
0	3.691281	4.193192	4.193192	4.193192
20	3.806628	4.501316	4.362110	4.291369
40	3.877284	4.528136	4.457336	4.429949
60	3.894216	4.733644	4.695307	4.646305
80	4.055372	4.878569	4.847844	4.810019
100	4.225522	4.983545	4.991296	4.968900
120	4.357733	5.134131	5.194401	5.154263
140	4.556012	5.266919	5.380943	5.366309
160	4.764462	-	-	-

TARGET E{IXI} = A/D CLIPPING LEVEL X (E{IXI}/RMS)/(PEAK/RMS)
= 127 X 0.7979/5.2 = 20